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SOME OBSERVATIONS ON THE MORPHOLOGY AND REPRODUCTION OF THE PHILIPPINE ISLANDS SKINK *MABUYA CUMINGI*

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(with two text-figures)

ABSTRACT.– A collection of 35 *Mabuya cumingi* from one locality on Luzon, Philippines, provides additional data on the species' morphology and biology. The parietal eye spot is variable and not correlated with either snout-vent length or sex. There is a significant correlation between the number of keels on the dorsal scales and the snout-vent length and between the head length and the number of maxillary teeth. There is a pronounced sexual dichromatism: males have prominent ventrolateral orange stripes which females lack. The species is oviparous. Females with large follicles or ovarian eggs range 40-45 mm (mean = 43.1 mm) in snout-vent length, have 2-3 eggs (mean 2.2) and were collected in a period coinciding with the end of the rainy season. In both sexes, snout-vent length is in slight positive allometry with head length. There is no significant difference between the sexes in either snout-vent length or the number of paravertebral scales. The presence or absence of pigment in the parietal peritoneum is variable in *Mabuya* and is likely to prove to be an important phylogenetic and/or ecological character.

KEY WORDS.– Allometry, *Mabuya*, parietal peritoneum, reproduction, Scincidae, sexual dimorphism, sexual dichromatism.

INTRODUCTION

In 1966, one of us (ST) collected a series of 35 *Mabuya* from along a stream bank on FM Hill (c. 15º 21' N, 120º 57' E) at Clark Air Force Base on Luzon, Philippines. Two specimens were collected in February, two in July and the rest in August. The skinks were collected in morning hours along footpaths through low secondary vegetation on a hillside adjacent to a small stream. These specimens remained in the collections of the University of Florida (UF 79941-79960, 135128-135142) identified only to genus until we examined them. We found them to be representatives of *M. cumingi* (Fig. 1) a species described in 1980 (Brown and Alcala, 1980) but virtually unreported on again since then other than for a range extension to Lanyu Island, Taiwan based on a single specimen (Ota and Huang, 2000). Our examination of these specimens revealed a number of new details about the species' morphology and reproduction, which we report here.

MATERIALS AND METHODS

Head length was measured to the nearest 0.1 mm with callipers between the tip of the snout and the centre of the external ear opening on the left side of the head. Snout-vent length was measured to the nearest 0.5 mm by applying the ventral surface of the straightened specimen to a steel rule. The number of keels per individual was the mean of the number of keels on five body scales on the mid-dorsum of the trunk.

The sex, reproductive state and colour of the parietal peritoneum were assessed through a pre-existing slit in the venter of the body. Colour was noted at the time of collection.

When both sides of a bilateral character are counted, we report the number of "cases"; otherwise we report the number of individuals as "n".

FIGURE 1: *Mabuya cumingi* (UF 135131). Photo. S. Humphreys.

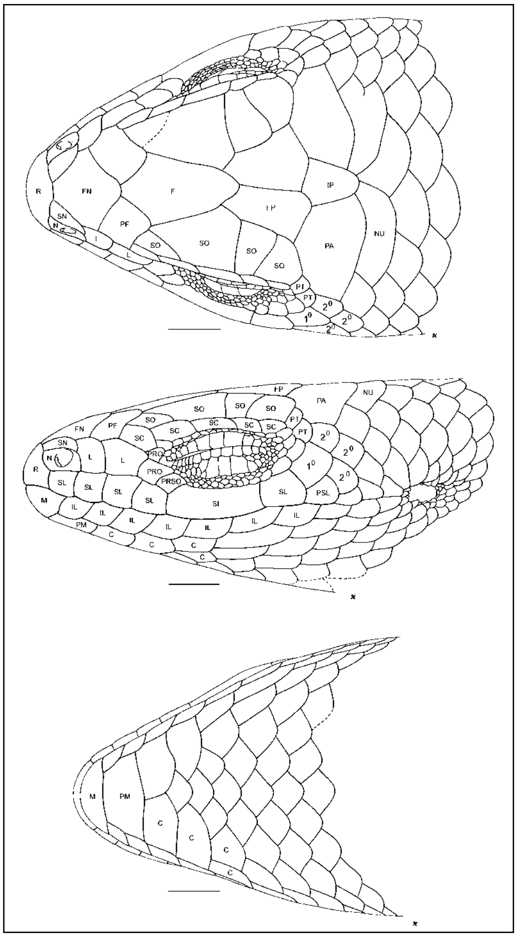

FIGURE 2: *Mabuya cumingi* (UF 72795) head scales. Abbreviations are as follows: C - chin scale; F - frontal; FN - frontonasal; FP - frontoparietal; IL - infralabial; IP - interparietal; L - loreal; M - mental; N - nasal; NU - nuchal; PF - prefrontal; PM - postmental; PRO - preocular; PRSO - presubocular; PSL - postsupralabial; R - rostral; SC - supraciliary; SL - supralabial; SN - supranasal; SO - supraocular; 1º - primary temporal; 2º - secondary temporal.

Statistical analysis was carried out using Systat 9.0 software. Statistical tests are identified in the text. The level of significance was 0.05.

Polarity of character states was made by reference to the *Pariocela* subgroup of *Eumeces* (see Greer et al., 2004, for rationale).

We do not adopt the recent taxonomic subdivision of the genus *Mabuya* (Mausfeld et al., 2002; Mausfeld and Schmitz, 2003), because we think its proposals are premature in light of the relatively few taxa analysed to date (see Greer et al., 2004).

RESULTS

Morphology. In the following summary of some of the species' systematically important characters, comparable observations in the original description (Brown and Alcala, 1980) are designated "BA" and given after our own observations. Supranasals separated medially (n = 35; BA, apparently always separated, n = ?); prefrontals usually separated (97.1 percent, n = 35) or rarely in contact (2.9 percent)(BA, apparently always separated, n = ?); parietals separated by interparietal (BA, 100 percent, n = ?); wide nuchals per side usually one (96.6 percent of 58 cases but rarely none (3.4 percent) or in other words, pairs of large nuchals usually one; postnasal joined to nasal; supraciliaries usually five (68.2 percent of 63 cases) but sometimes four (27.0 percent) or rarely six (4.8 percent); anteriormost supraciliary contacts prefrontal (100 percent of 69 cases); primary temporals usually one (92.3 percent of 65 cases) but occasionally two (7.7 percent); secondary temporals in 2S (86.2 percent of 65 cases) or 2C (13.8 percent) configuration (Greer and Broadley, 2000); upper secondary temporal overlapped by parietal (100 percent of 65 cases); postsupralabials one (100 percent of 66 cases); postmental contacts two infralabials on each side; first pair of large chin scales in contact; second pair of chin scales separated by one scale row, and third pair of chin scales divided and separated by three scale rows (Fig. 2).

The parietal eyespot is faintly evident in nine of the 35 specimens, but its occurrence is not significantly associated with either snout-vent length (Mann-Whitney U = 97.0, P = 0.54, n

= 34) or sex (Fisher's Exact test, P = 0.41, n = 29).

Snout-vent length 20-48.5 mm (mean = 35.9 mm, n = 34; BA, 39.4-54 mm, n = 26 mature specimens); longitudinal scale rows at midbody 30-32 (mean = 31.5, n = 6; BA, 28-32, n = ?); paravertebral scales 38-46 (mean = 41.8, n = 22; BA, 40-47, n = ?); subdigital lamellae 17-21 (mean = 18.8, n = 17; BA, 16-21 overall but usually 18-20, n = ?).

The number of keels on the middorsal body scales ranges 3-5 (BA, 5-7, rarely 9, n = ?). There is a significant positive relationship between the mean number of keels and snout-vent length (r^2 = 0.82, p < 0.0001, n = 31).

Osteology. Premaxillary teeth 10 (n = 8); vomers fused (n = 3); pterygoid teeth present (n = 3); maxillary teeth 17-24; postorbital distinct but small (n = 1).

There is a significant positive relationship between the number of maxillary teeth and the head length (r^2 = 0.96, P = 0.0036, n = 5).

Presacral vertebrae usually 26 (n = 21), rarely 25 (n = 1). Phalangeal formula for manus and pes, 2.3.4.5.3 and 2.3.4.5.4, respectively.

Colour. In preservative, parietal peritoneum pale; tongue pale except for tip, which is dark.

In life, a sexual dimorphism in coloration was noted among the series collected in July and August 1966. All mature males had prominent ventrolateral orange stripes approximately 3-5 scales in width along both sides. Both sexes had a medium brown dorsum and grayish venter, with a darker brown lateral stripe extending from the angle of the jaw slightly past the forearm.

Reproduction. Five females carry either yolking ovarian eggs or shelled oviducal eggs. These females range 40-45 mm (mean = 43.1 mm) in snout-vent length and have 2-3 eggs (mean 2.2). The shells on the oviducal eggs are thick and suggest that the species is oviparous. All five specimens were collected in the period 3-7 August. This period coincides with the end of the rainy season.

Allometry. In both males and females, snout-vent length is in slight positive allometry with head length. The relative equation for log transformed data for males is: log snout-vent length = 0.44 + 1.20 log head length with a 95 confidence interval for the slope of + 0.18 (r^2 = 0.92, P < 0.0001, n = 17) and for females is: log snout-vent length = 0.36 + 1.32 log head length with a 95 confidence interval for the slope of + 0.30 (r^2 = 0.88, P = 0.0005, n = 13). In other words, in both sexes, snout-vent length becomes slightly larger (more elongate) relative to head length with increasing size.

Sexual dimorphism. There is no significant difference between the sexes in either snout-vent length (Mann Whitney U = 78.5, P 0.26) or the number of paravertebral scales (Mann Whitney U = 48.5, P = 0.97).

DISCUSSION

The species shows a number of derived character states within *Mabuya*. These include: supranasals separated (character 1); prefrontals separated (2); nuchal pairs one (3); postnasal absent (4); upper secondary temporal overlaps parietal (5); secondary temporal condition modally 2S (6); postsupralabials one (7); auricular lobules absent (8); premaxillary teeth ten (9) and vomers fused (10). These characters, to the extent that we have information on them, are shared only with the following three species: *M. englei* (characters 5, 6, 9 and 10 not examined) and *M. multicarinata* (characters 3, 5, 9 and 10 not examined) from the Philippines and *M. allapalensis* (characters 5, 6, 9 and 10 not examined) from India. In the original description of *M. cumingi*, *M. englei* was identified as the species most similar to it (Brown and Alcala, 1980).

The number of paravertebral scales, 38-46 (mean = 41.8) is relatively low for skinks (pers. obs.) and lower than for at least some other *Mabuya*, e.g., *M. dissimilis* with 46-60 (Greer et al., 2004).

The variability of the parietal eyespot in *Mabuya cumingi* is difficult to explain as it is not correlated with either size or sex. When the parietal eye spot is present in *M. cumingi*, it is only weak at best, and its weak development may foreshadow in some functional way, the apparent complete loss of the parietal eyespot in two Asian species, *M. rudis* and *M. rugifera*.

The strong positive correlation between the number of keels on the dorsal scales with in-

creasing snout-vent length is a common feature in many, but not all skinks, with keeled scales, including *Mabuya* (AG, pers. obs.).

The strong correlation between the number of maxillary teeth and head length has been reported for only one other species of skink, *Ctenotus essingtoni* (Greer, 1991). However, the relationship is probably fairly general in skinks (AG, pers. obs.).

The pale parietal peritoneum of *Mabuya cumingi*, is typical of other Asian species of *Mabuya* and in contrast to the dark parietal peritoneum of African, Madacasgan and American species (AG, pers. obs.).

The oviparous mode of reproduction is significant in comparison to the live-bearing mode of reproduction in *Mabuya multifasciata*, the south-east Asian species with which *M. cumingi* was previously confused and with which it shares a number of derived characters (above).

The positive allometry of snout-vent length relative to head length of *Mabuya cumingi* is probably widespread in skinks (AG, pers. obs.). The relationship indicates that with increasing size, snout-vent length increases relative to head length; in other words, larger individuals are more elongate. As the number of presacral vertebrae is constant, this elongation of the body must be due to the elongation of at least some, if not all, of the presacral vertebrae.

The absence of a significant sexual dimorphism in the snout-vent length in *Mabuya cumingi* is unusual. In most skinks, females are significantly larger than males (AG, pers. obs.). However, a significant sexual dimorphism in snout-vent length is also lacking in the Asian *M. dissimilis* (Greer et al., 2004).

The absence of a significant sexual dimorphism in the number of paravertebral scales in *Mabuya cumingi* is unusual. In most skinks, females have significantly more paravertebral scales than do males (AG, pers. obs.), including the only other *Mabuya* examined in this regard, *M. dissimilis* (Greer et al., 2004).

The specimens we examined differ little from the original description of the species. Perhaps the most significant differences are the smaller maximum snout-vent length of our specimens (48.5 mm, n = 34 vs. 54 mm, n = 26) and the fewer number of keels per dorsal body scale (3-5 vs. 5-7, rarely 9). The difference in maximum snout-vent length could be due to chance and/or seasonal or geographic variation. And the difference in number of keels could be due to the size range of the specimens examined. Maximum snout-vent length, as noted, was greater in the type series.

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INLE LAKE TURTLES, MYANMAR WITH NOTES ON INTHA AND PA-O ETHNOHERPETOLOGY

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(with five text-figures)

ABSTRACT.– We investigated the occurrence and conservation status of turtles at Inle Lake, Myanmar during December 2003 and January 2004. During this survey we verified the occurrence of extant populations of *Cyclemys dentata* and *Amyda cartilaginea* at Inle Lake, and *Indotestudo elongata* in the surrounding uplands. Furthermore, interview data strongly suggest that *Nilssonia formosa* formerly occurred in the lake, but has recently been extirpated. Traditional exploitation of turtles at Inle Lake was minimal, but the situation changed abruptly during the mid-1990's in response to demand from burgeoning wildlife markets in southern China. Commercial over-harvesting now threatens the viability of turtle populations remaining at Inle Lake. The harvest of *I. elongata* remains largely for subsistence, but in combination with frequent anthropogenic wildfires may constitute a long-term threat to tortoise populations. Additionally, we report on the ethnobiological knowledge and cultural practices of local indigenous groups regarding chelonians.

KEYWORDS.– Turtles, Inle Lake, Myanmar, *Amyda cartilaginea*, *Cyclemys dentata*, *Indotestudo elongata*, *Nilsonnia formosa*, ethnoherpetology, Intha, Pa-O, conservation.

INTRODUCTION

Species inventories of particular regions provide essential data sets for conservation (Oliver and Beattie, 1993), and acquiring baseline data on the distribution of even common species is important (Dodd and Franz, 1993). Accurate distributional data are fundamental to understanding community and ecosystem dynamics (Andrewartha and Birch, 1954), and can affect conservation priorities (Stuart and Thorbjarnarson, 2003). Despite high levels of species richness and endemism (23 species; 6 endemic), the chelonian fauna of Myanmar ranks among the least known in Asia (Iverson, 1992; van Dijk, 1997; Platt et al., 2000). Fragmentary observations, many originating prior to 1900, are the principal source of information, and the distribution and conservation status of many species remain poorly known (van Dijk, 1993, 1997; Platt et al., 2000; Thorbjarnarson et al., 2000b).

In particular, the chelonian fauna of Inle Lake, one of two large inland lakes in Myanmar (Chhibber, 1933) has received little attention. A biological inventory conducted by the Zoological Survey of India during February-March 1917 focused primarily on fish (Annandale, 1918a) and invertebrates (Annandale, 1918b, 1918c; Kaburaki, 1918; Kemp, 1918; Pavia, 1918; Stephenson, 1918), with only brief mention of turtles (Annandale, 1918d). More recent investigations have mainly concerned wading birds and waterfowl (King, 1983; Sayer and Saw Han, 1983), and Inle Lake is now recognized as a globally significant wintering site for migratory birds (Scott, 1989). However, nothing is known regarding the contemporary occur-

rence and conservation status of turtles in Inle Lake. Such data are urgently needed given the intensive exploitation of chelonians now underway throughout Myanmar to supply commercial wildlife markets in southern China (Platt et al., 2000). Rampant over-harvesting has severely depleted many chelonian populations (Platt et al., 2000; 2001a; 2003a), and some species may be on the verge of biological or local extirpation (e.g., *Kachuga trivittata* and *Batagur baska*; Thorbjarnarson et al., 2000b; Platt, 2001).

Furthermore, the traditional ecological knowledge of various ethnic groups in Myanmar has long been overlooked by investigators, and virtually nothing is known concerning ethnoherpetology in the country (but see Annandale and Shastri, 1914). Unique cultural knowledge about plants and animals is often encoded in terms specific to individual languages, and linguistic diversity is considered an index of the specialized ethnobiological knowledge of a region (Nabhan, 2003). Because over 100 different languages and dialects are spoken in Myanmar (Roberts et al., 1968; Diran, 1997), the country thus appears to offer a fertile ground for ethnobiological investigation. Although Buege (1996) cautions that indigenous people should not be regarded as "ecologically noble savages" who live in harmony with nature, nonetheless indigenous ethnobiological knowledge may provide insights into natural history and ecological relationships overlooked by academic investigators, unique solutions critical to the survival of endangered species, utilitarian benefits to western society in the form of novel pharmaceuticals and natural products, and a greater understanding of local biological and cultural diversity (Goodman and Hobbs, 1994; Berkes, 1999; Nabhan, 2003). Here we present the results of a recent investigation into the occurrence and conservation status of chelonians at Inle Lake, and the ethnobiological knowledge of local indigenous groups regarding turtles.

STUDY AREA AND METHODS

Inle Lake (22º 35'N; 96º 57'E) lies approximately 915 m above sea level in a steep-sided valley of the Shan Plateau in eastern Myanmar (Fig. 1 and 2). The lake extends for approximately 22 km in a north-south direction and has a maximum width of about 6 km (Chibber, 1933; Thet Tun and Sayer, 1983). Estimates of the surface area of open water in the lake range from 145 to 158 km² (Chibber, 1933; Thet Tun and Sayer, 1983) owing to the irregular, poorly defined shoreline and on-going siltation (see below). Surrounding hills rise 300 to 600 m above the lake and continuing, long-term siltation from these uplands has created extensive alluvial plains at the northern and southern ends of the lake, and to a lesser extent along the western shore (Chhibber, 1933; Thet Tun and Sayer, 1983). Maximum water depth is only 3.6 m during the dry season (October to May) and increases by about 1.0 m after the onset of the wet season (Chhibber, 1933; Scott, 1989). The Nam Pilu Chaung flows from the southern end of the lake into the Salween River drainage and dampens extreme seasonal water level fluctuations.

Inle Lake is characterized by a central body of open water with an extensive wetland fringe. The shallow open waters of the lake support

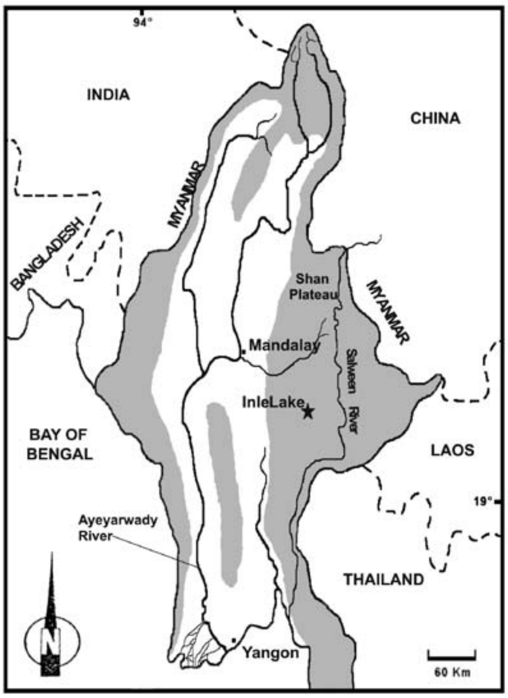

FIGURE 1: Map of Myanmar showing approximate location of Inle Lake. Shading denotes hill ranges and mountains.

dense stands of submerged vegetation such as *Potamogeton*, *Najas*, and *Chara*, while the marsh is dominated by *Phragmites*, *Saccharum*, *Scirpus*, and *Sagittaria* (Fig. 3). Floating peat mats between the marsh fringe and open water support a distinct plant community consisting of *Cyperus*, *Cladium*, and ferns, with *Phragmites* being conspicuously absent (Fig. 4). An additional 195 km^2 of *Typha* and *Phragmites* wetlands occur on alluvial deposits at the northern and southern ends of the lake. Significant areas of *Typha-Phragmites* wetlands have been drained and converted to agricultural fields (pers. obs.). Deciduous Dipterocarp forest occurs on the steep limestone hills surrounding Inle Lake. Our observations indicate that much of this forest is secondary growth resulting from frequent clearing and burning by *taungya* (=shifting) cultivators (Fig. 5). Nath (1961) provides a complete description of the vegetation in eastern Shan State, including Inle Lake.

The Intha and Pa-O are the principal ethnic groups inhabiting Inle Lake and the surrounding uplands (Diran, 1997). Approximately 70,000 Intha dwell in elevated villages on the lake and the town of Nyaungshwe (Thet Tun and Sayer, 1983; Diran, 1997). Fishing and agriculture are the major economic endeavors of the Intha (Diran, 1997). The Intha harvest at least 20 of the 31 species of fish recorded from the lake using nets and bamboo fish traps (Annandale, 1918a). Most notably, large conical bamboo baskets covered in netting with no bottom and only a small hole at the top, are placed over mats of submerged vegetation and fish are speared through the opening at the top (Annandale, 1918a). Additionally, the Intha practice a distinctive form of agriculture whereby vegetables are grown on floating peat marsh (Annandale, 1918e). The Pa-O occupy permanent villages in the uplands surrounding Inle Lake. Like most hill tribes in eastern Myanmar, the Pa-O are *taungya* cultivators, planting crops, primarily wheat, corn, and beans in clearings hewn from the forest and then burned (Kingdon Ward, 1944). The Pa-O also maintain extensive hillside orchards of *Cordia* sp., the leaves of which are used to manufacture cheroots (Diran, 1997).

In 1985, 635 km^2 of Inle Lake, wetlands, and adjacent hill forests were designated as a wildlife sanctuary to be managed by the Wildlife Conservation Division of the Myanmar Forest Department (Myanmar Forest Department, unpubl.). The primary focus of the sanctuary is waterfowl conservation, but other wildlife are protected as well (U Than Htay, pers. comm.). Agriculture and fishing are permitted throughout the sanctuary except in an ill-defined core area centered on bird observation towers at the northern end of the lake. Inle Lake is now a major destination for domestic and foreign tourists (Martin et al., 2002). Tourist developments and an associated increase in motor boat traffic are believed to pose a serious threat to the continued ecological integrity of the lake (Aonyx Environmental Services, 2002).

We conducted fieldwork at Inle Lake and vicinity from 26 December 2003 to 3 January 2004. During this period we visited fishing villages throughout the lake and farming communities in the nearby hills, and interviewed fishermen, hunters, farmers, and other knowledgeable persons regarding the local occurrence of turtles, levels of exploitation, collecting methods, traditional use, and general knowledge of turtles. Such individuals are typically an excellent source of information on local chelonian fauna (Thirakhupt and van Dijk, 1994; Platt et al., 2003a, 2003b). Transcripts of all interviews are contained in fieldnotes archived in the Campbell Museum, Clemson University, Clemson, South Carolina, USA. Available specimens were examined, measured, and photographed. Vouchers were obtained if possible and deposited in the natural history collection of the Wildlife Conservation Society Myanmar Program (Yangon). We also accompanied villagers to specific sites where turtles were captured or observed to obtain information on habitat. Straight-line carapace length (CL) is presented as mean ± 1SD.

Finally, it should be noted that in a recent revision of the genus *Cyclemys*, Guicking et al. (2002) contend that *C. dentata* is actually a complex of cryptic species, and the species occurring in the Shan Hills of Myanmar is *C. shanensis*. However, pending resolution of the on-going debate concerning species boundaries

in *Cyclemys* (Fritz et al., 1997; Fritz and Ziegler, 1999; Guicking et al., 2002; Stuart and Platt, 2004), we follow traditional taxonomy (e.g., Ernst and Barbour, 1989; Iverson, 1992) and refer to *Cyclemys* at Inle Lake as *C. dentata*.

RESULTS AND DISCUSSION

Species diversity.- Our survey verified the occurrence of extant populations of Asian leaf turtle (*Cyclemys dentata*) and Asiatic softshell turtle (*Amyda cartilaginea*) at Inle Lake. *Cyclemys dhor* (at present synonymous with *C. dentata*) was the only species collected during the 1917 survey, but based on reports from fishermen Annandale (1918d) speculated that a softshell, most likely *Trionyx phayrei* (*Amyda cartilaginea*), also occurred in the lake. We obtained shells of 25 *C. dentata* (CL = 157 ± 36 mm; range = 85 to 203 mm), known locally as *leik pu* or "dwarf turtle", possibly owing to its small body size when compared to the much larger softshells inhabiting the lake (see below). According to fishermen, *C. dentata* occurs in heavily vegetated marshlands and rarely ventures into open waters of the lake. Females reportedly nest on mats of floating peat marsh and in soil along the western and eastern shoreline. In comparison to *C. dentata* examined elsewhere in Myanmar (Platt et al., 2001b), the carapace and plastron of specimens from Inle Lake are notably darker, and almost black in many cases. Villagers attribute the dark colouration of these turtles to staining by the peat substrate.

We obtained the shells of eight *Amyda cartilaginea* (CL = 186 ± 38 mm; range = 130 to 240 mm) from fishermen during this investigation. These specimens are considerably smaller than the maximum reported CL of 700 mm (Ernst and Barbour, 1989). The vernacular name for *A. cartilaginea* is *kabhar leik*, which literally translates to "Earth turtle", and derives from the local belief that this species is extremely long-lived, i.e., large individuals are as "old as the Earth". *A. cartilaginea* is found throughout the lake, and fishermen seek them beneath mats of floating marsh and among beds of submerged aquatic plants. In the past females reportedly nested at well-known sites near Fort Stedman.

Additionally, informants identified a second species of softshell known as *leik kyi*, or "transparent turtle", so-called because the four Burmese religious characters (*Sa*, *Da*, *Ba*, *Wa*) are clearly discernible on the carapace, said to attain a carapace length of almost 1.0 m. We were unable to obtain a specimen for positive identification, but the four religious characters are almost certainly a reference to the prominent carapacial ocelli of the Burmese peacock softshell turtle (*Nilssonia formosa*). Although the reported carapace length is considerably larger than given in most published accounts (274 to 400 mm; Annandale, 1912; Smith, 1931; Ernst and Barbour, 1989), we have observed *N. formosa* approaching this size (CL ca. 700 to 800 mm) in temple ponds of Mandalay and Yangon (S. Platt and Kalyar, unpubl. data).

The elongated tortoise (*Indotestudo elongata*) was the only chelonian we documented in the uplands surrounding Inle Lake, although *C. dentata* is said to be found occasionally in hill streams. We examined five *I. elongata* shells (CL = 195 ± 33 mm; range = 144 to 233 mm) obtained from villagers. A female (CL = 233 mm) captured in July 2003 reportedly contained three shelled eggs. *Indotestudo elongata* is known locally as *kone leik* (=highland turtle) and occurs in ruderal habitats ranging from low scrub to dense second-growth forest. Villagers note that tortoises consume mushrooms, and often congregate beneath *thepan* trees (*Ficus* spp.) to feed on fallen fruits. During the dry season *I. elongata* reportedly move into riparian vegetation along permanent hill streams. Villagers attribute variation in carapace pigmentation to soil hue; the darker the soil, the more extensive the pigmentation on each scute.

Exploitation.- According to our informants, subsistence exploitation of turtles at Inle Lake was historically minimal owing to the abundance of fish. What harvest that did occur was incidental to other fishing activities and even then, captured turtles were often released unharmed. Turtles were said to be particularly common beneath elevated houses on the lake, where villagers fed them kitchen waste and occasionally cooked rice. The situation changed

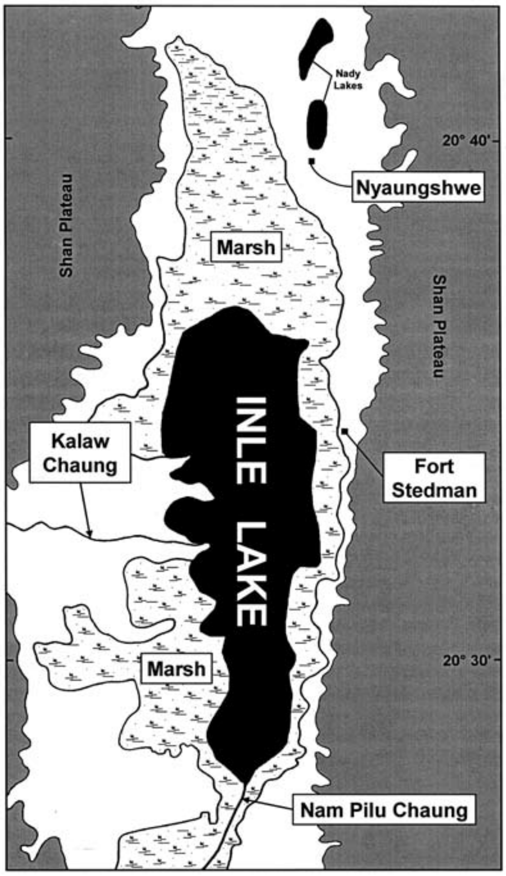

FIGURE 2: Map of Inle Lake showing localities mentioned in text. Upland regions surrounding the lake are shaded.

FIGURE 3: *Phragmites* marsh comprising wetland fringe around Inle Lake. This marsh type is inhabited by *Cyclemys dentata*.

FIGURE 4: Marsh on floating peat substrate in northern Inle Lake. *Cyclemys dentata* occurs amidst thick marsh vegetation and females reportedly nest in peat substrate. Fishermen capture *Amyda cartilaginea* beneath floating mats. Note uplands in distance.

FIGURE 5: Dense second-growth vegetation typical of hills surrounding Inle Lake and inhabited by *Indotestudo elongata*. Thick vegetation provides some degree of protection to tortoises by deterring hunters.

abruptly in the mid-1990's when wildlife traders from Taungyi began visiting Intha communities to purchase living turtles and shells for eventual export to southern China. This period coincides with a dramatic increase in the harvest of wild chelonians throughout Southeast Asia to supply burgeoning Chinese wildlife markets (Compton, 2000), where an especially high demand for softshell turtles exists (Lau and Shi, 2000).

The Intha now employ a variety of methods to harvest turtles. *Cyclemys dentata* are captured in bamboo fish traps baited with aquatic snails, and during December and January fishermen use sharpened sticks to probe for *A. cartilaginea* buried in the mud. Both *C. dentata* and softshells are taken on set-lines (*phaungs*)

and hooks baited with small fish. Softshells are speared after being caught in the traditional fishing baskets described earlier. Several informants also claimed to catch turtles using rice-balls laced with a commercial vitamin B-12 preperation. After consuming this bait, the turtle is said to become lethargic and float to the surface where it is easily netted. The physiological mechanism underlying this method is unclear. According to the fishermen we interviewed, harvest levels have decreased significantly in recent years, probably as a result of declining turtle populations in the lake (see below). Individuals reported capturing 0 to 5 *A. cartilaginea* and 5 to 10 *C. dentata* in 2003. A wildlife trader claimed to have purchased "about 100" *C. dentata*, but only 5 *A. cartilaginea* during the same period.

In contrast to the situation on the lake, few Pa-O deliberately hunt tortoises. Despite high market demand the harvest remains largely opportunistic and captured tortoises are locally consumed rather than being sold. A few individuals employ dogs to hunt tortoises, but unlike other regions of Myanmar (Platt et al., 2001a, 2003b) this practice does not appear widespread. Moreover, the ruderal hill vegetation apparently provides some degree of protection for *I. elongata*; villagers maintained this vegetation is difficult to penetrate and tortoises are so well-concealed by the dense growth that hunting is not worth the effort. Most *I. elongata* are reportedly taken by farmers while clearing land for cultivation or in the wake of anthropogenic wildfires set late in the dry season (March to May). The number of *I. elongata* taken appears low and individuals reported capturing 1 to 7 tortoises annually.

Population status and conservation.- Little historical data is available to assess the past abundance of turtles in Inle Lake making conclusions regarding current population trends somewhat speculative. Unfortunately Annandale (1918d) failed to provide even qualitative impressions of abundance and the 1917 survey party collected only a single turtle (*C. dentata*; ZSI 18594) from the lake. However, Annandale (1981d) did state that *C. dentata* "is… [observed]… sitting at the edge of canals …", which seems to imply that the species was frequently observed. Anecdotal data gathered during our survey strongly suggest that turtle populations in the lake have suffered a catastrophic decline since commercial harvesting began in the mid-1990's. First, the consensus among those interviewed is that harvests have decreased sharply in recent years, and this is generally attributed to over-collecting. Fishermen now consider *C. dentata* and *A. cartilaginea* rare and difficult to catch in numbers sufficient to justify the effort. Furthermore, *N. formosa* is believed to be locally extirpated or nearly so, and no one we interviewed had encountered the species since 2000. Tortoise populations in the surrounding hills appear to have fared better. Perceptions of *I. elongata* abundance varied among the Pa-O we interviewed; some regard them as rare, while others indicate that tortoises remain common.

Clearly, intensive commercial over-exploitation appears largely responsible for the precipitous decline of turtle populations that has apparently occurred in Inle Lake, and continued harvest makes the long-term viability of these populations questionable. Life history traits of long-lived organisms such as turtles severely constrain the ability of populations to respond to chronic over-harvesting (Congdon et al., 1993). Furthermore, there is no compensatory response among juveniles to increased adult mortality (Brooks et al., 1991). Therefore most chelonian populations are unable to withstand even low to moderate levels of increased mortality (Klemens and Moll, 1995). The take of *I. elongata* remains an opportunistic subsistence harvest and thus is less likely to result in an acute population decline. However, our research in central Myanmar (Platt et al., 2001a, 2003b) indicates that even low levels of subsistence harvest can have negative long-term impacts on tortoise populations, and Thirakhupt and van Dijk (1997) conclude that subsistence harvesting severely depleted most turtle populations outside of protected areas in western Thailand. Indeed, Thorbjarnarson et al. (2000a) question whether any level of harvest can be regarded as truly sustainable. Moreover, anthropogenic dry season wildfires may constitute an additional source of human-induced mortality for *I. elongata*, especially hatchlings and juveniles (Thira-

khupt and van Dijk, 1994; Mitchell and Rhodin, 1996; Platt et al., 2001a).

Ethnoherpetology.- We documented a variety of uses and beliefs regarding chelonians among the Intha and Pa-O. Both groups consider turtle meat a powerful aphrodisiac, and while inquiring about the local availability of turtle shells, we were frequently directed to the homes of elderly men, where the shells of *C. dentata* and *I. elongata* were obtained. The Pa-O use *I. elongata* to prepare an antidote for mushroom poisoning in humans, a practice stemming from the observation that tortoises consume toxic mushrooms and yet suffer no ill-effects. To prepare the antidote, tortoise heads are dried slowly beside a fire and then pulverized, and the resulting powder mixed with water and administered orally.

Although the Intha historically harvested few turtles, eggs were avidly sought for local consumption. Most were collected opportunistically by farmers while preparing gardens on floating peat mats; however, significant numbers were also unearthed from well-known nesting areas along the lakeshore. The Intha describe turtle nests as consisting of three tiers of eggs, each separated by a thin layer of soil or peat. The first tier is sacrificed to predators, primarily crows (*Corvus* spp.) and Brahminy kites (*Haliastur indus*). The second tier is available for human use, and the third ensures the next generation of turtles. Although many chelonians deposit multiple clutches during a single reproductive season (Gibbons, 1982), we are unaware of any that partition individual clutches into layers. We speculate that this belief originated when villagers found multiple clutches buried in close proximity within a limited nesting area. Although this belief suggests there is some cultural control of the traditional egg harvest, we found nothing to indicate that villagers actually leave any eggs *in situ* to hatch. Those interviewed stated that all eggs are removed from nests, otherwise someone else would surely collect them. Informants further noted that turtle nests are rarely found anymore, and attributed this to declining turtle populations in the lake.

The Intha also suspend turtle carapaces alongside broken clay drinking vessels above pig pens. The significance of the broken vessel is unclear, but in combination with a turtle carapace it is believed to stimulate growth and ward off supernatural beings thought responsible for infectious diseases among swine. The carapace of any turtle will suffice, but those of *I. elongata* are especially valued as the configuration of annuli on each scute is thought to resemble the concentric pattern of Burmese pagodas and impart great power to tortoise shells. Although well known to the villagers we interviewed, this practice was largely discontinued after wildlife traders began purchasing shells to supply traditional Chinese medicinal markets.

Summary.– In conclusion, our investigation highlights the serious threat to turtle populations at Inle Lake posed by rampant commercial overharvesting to meet the seemingly insatiable demands of Chinese wildlife markets. Moreover, Inle lake is not an isolated case and reflects the general situation with regards to chelonians throughout much of Myanmar. On the local level, every effort must be made to curtail the harvest of turtles and turtle eggs at Inle Lake. The commercial harvest of any species of chelonian is illegal according to domestic fisheries and forestry legislation, and all wildlife is protected in wildlife sanctuaries and national parks (Platt et al., 2000); however, enforcement of these laws at Inle Lake remains minimal, presumably due to budgetary and manpower constraints. Most importantly it is imperative for Myanmar and Chinese officials to curb the trans-border wildlife trade between the two countries. This trade is in clear violation of CITES, which Myanmar signed on 13 June 1997 (Platt et al., 2000). Unless protective measures are implemented soon the demise of much of Myanmar's unique chelonian fauna is to be expected. This is noteworthy not only from the standpoint of biodiversity, but given the importance of turtles as food, medicine, and even shamanistic icons to indigenous peoples, it represents a significant cultural loss as well.

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REPORT ON THE HERPETOFAUNA FROM THE TEMENGOR FOREST RESERVE, PERAK, WEST MALAYSIA

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(with 15 text-figures)

ABSTRACT.– A herpetofaunal survey was carried out in a logging concession in Temengor Forest Reserve, Hulu Perak, Perak Darul Ridzwan, West Malaysia. The survey documents 32 species of amphibians and 25 species of reptiles representing five and seven families, respectively. Five species of frogs, one species of caecilian, 15 species of lizards and four species of snakes are newly reported from the area, including an undescribed species of flying frog (*Rhacophorus*).

KEY WORDS.– Herpetofaunal survey, Malaysia, Temengor, *Rhacophorus, Sphenomorphus.*

INTRODUCTION

Sukumaran (2002) reported on the amphibian fauna within the Perak Intergrated Timber Complex (PITC) located in Hulu Perak, Perak Darul Ridzwan, northern peninsular Malaysia in the Temengor Forest Reserve. This was the second herpetological survey of Temengor Forest Reserve. In a combined expedition Diong et al. (1995) reported on the lizards and Lim et al. (1995a, b) reported on the snakes and turtles, respectively. Kiew et al., (1995) and Norsham et al., (2001) inventoried the greater Belum-Temengor forest area and Temengor area, respectively (Fig. 1). Sukumaran (2002) reported 26 species of frogs from five families and seven species of reptiles representing four families. To this report we add five species of frogs, one caecilian, 15 species of lizards, and four species of snakes.

LOCATION

The PITC logging concession is located between 05° 24' 40" to 05° 34' 15"N; 101° 33' 00" to 101° 39' 30"E (Fig. 1). The concession comprises 9,000 ha of mostly primary hill and upper hill mixed dipterocarp forests just south of the Belum Protected Area in the Temengor forest. The major drainage system of this area is the east-west flowing Sungai (Sg.) Selaur and its surrounding tributaries located just to the north of the concession's border.

The survey focused on a 1,500 ha. region in the northern portion of the concession where logging operations have been in progress for nearly two years. The elevation of the concession ranges from 500 m to just over 1000 m. Our efforts were concentrated in areas between 500–800 m. Collections were made on the hillsides and ridges within hill and upper-hill mixed dipterocarp forests as well as the flat floodplain areas associated with the major drainage systems.

METHODOLOGY

The survey was conducted from 19–27 August 2003, during the Southwest Monsoon season, a relatively drier period of the year in this area. Weather was generally hot (> 30C°) with cloudless days and nights. One episode of significant rain fell during the afternoon of 23 August but ceased before nightfall, and there was heavy rain reported from the area in the week imme-

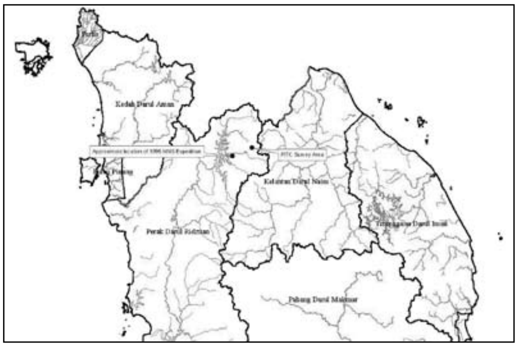

FIGURE 1: Location of PITC logging camp in Perak, Malaysia.

FIGURE 2: Sungai Selaur.

diately preceding the surveys, but the survey period was otherwise dry.

Walking surveys were carried out daily by six people between the hours of 0900–1400 and 2000–0100. Nighttime surveys were conducted with head lamps and hand-held flashlights whereas daytime surveys were aided by 10 x 50 power binoculars and 72” aluminum 40 caliber blow pipes. Specimens were photographed, euthanized, tissued for liver, preserved in 10% formalin, and deposited in the Forest Research Institute Malaysia (FRIM).

Surveys were carried out both day and night in five areas within the logging concession, corresponding to four habitat types: (a) small streams and creek, (b) larger streams and rivers, (c) floodplains, and (d) hill slope and dry land forests. The description of habitats is presented in Sukumaran (2002). In addition, a number of observations were made on the logging roads and around the logging camp (N5.56186 E101.61177) which are included in this report.

Sg. Selaur (Fig. 2). This site was also surveyed by Sukumaran (2002), but was referred to by the Orang Asli name, Sg. Jelud. It is a large (8–12 m) fast-flowing river at about 550 m in elevation with boulders and sandy substrate, flowing just north of the PITC concession boundary (N05.56599; E101.60948). Large heavily-veg-

FIGURE 3: Floodplain habitat along Sungai Selaur.

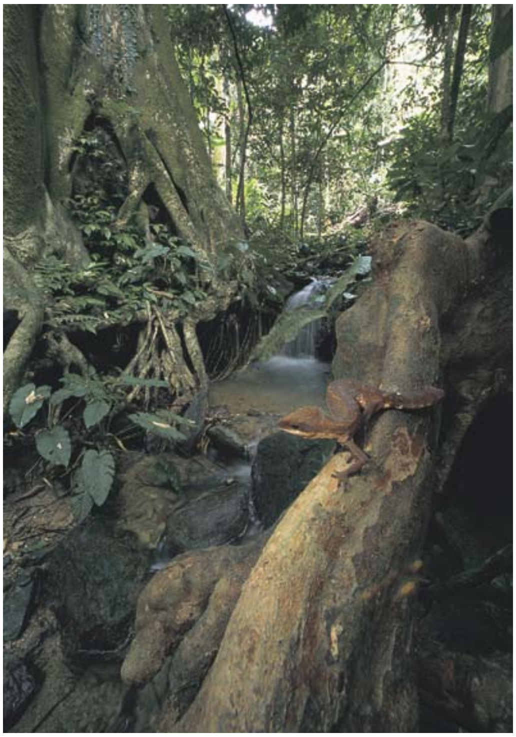

FIGURE 4: Kuhlii creek.

FIGURE 5: Gibbon trail.

etated floodplains can be found in certain areas along its length.

Sg. Selaur Floodplains (Fig. 3). As mentioned above, forested floodplains or benches can be found along the length of Sg. Selaur. These were generally large, flat areas with stands of tall trees and sparse undergrowth.

Kuhlii Creek (Fig. 4). This is a small (< 2 m width) creek running along a steep-sided valley within the complex at approximately 550 m in elevation within lowland mixed dipterocarp forest.

Gibbon Trail (Fig. 5). This trail runs through hill mixed dipterocarp forest along the ridge of a series of hills, at approximately 750 m in elevation.

Skink Trail (Fig. 6). This trail runs through hill mixed dipterocarp forest at approximately 850 m elevation.

RESULTS

Fifteen species of lizards representing five families and four colubrid snakes are reported from this region for the first time. Five additional species of frogs from three families as well as one species of caecilian that were not reported by Sukumaran (2002) were also observed and are reported here. All species and habitats in which they were found are listed in Table 1. Discussions of species observed in the area are presented below, and comparisons are made between the observations of the present survey and the one carried out in 2002. Vouchered specimens are listed with the FRIM acronym.

AMPHIBIA (Anura)

A total of 30 species of anurans in all five West Malaysian families were documented in the sites during the surveys, with four species of bufonids, three species of megophryids, three species of microhylids, 14 species of ranids and six species of rhacophorids.

Bufonidae

Bufo asper Gravenhorst, 1829 (FRIM 1147-1148)

This species was encountered along the main river (Sg. Selaur) as well as on the edges and

FIGURE 6: Skink trail.

banks of the logging roads. Only smaller individuals were observed on the logging roads (away from the rivers). Vocalizations of this species were heard every night from the main river.

Bufo parvus Boulenger, 1887 (FRIM 1223)

Calling aggregations were heard from a swampy area adjacent to "Kuhlii Creek" during the evening throughout the survey period. In general, the advertising activity of this species was much less during this period when compared to the 2002 survey.

Leptophryne borbonica (Tschudi, 1838) (FRIM 1149-1150)

Individuals were collected from along the major logging roads. In addition, calling aggregations were heard on the evening of 25 August in the swampy area adjacent to "Kuhlii Creek".

Pedostibes hosii (Boulenger, 1892) (FRIM 1151)

A single male (Fig. 7) was collected from its perch on a medium-sized tree branch overhanging Sg. Selaur approximately 2.5 m above the ground. No vocalizations of this species were noted, in contrast to the 2002 survey.

Megophryidae

Leptolalax heteropus (Boulenger, 1900) (FRIM 1152)

This species was observed vocalizing and collected from vegetation (ferns and small bushes) along "Kuhlii Creek". No individuals were noted in the floodplains along Sg. Selaur, in contrast to the 2002 survey.

Megophrys nasuta (Schlegel, 1837) (FRIM 1153)

High levels of advertising activity were noted during the survey period, with vocalizations noted throughout the forest day and night. A single, large gravid female was collected from the Sg. Selaur floodplain.

Megophrys aceras (Boulenger, 1903) (FRIM 1154)

A single male individual was collected from under leaf-litter by the base of a tree in the forest along "Skink Trail". It was much more red than any other specimens previously collected (Fig. 8).

Microhylidae

Microhyla berdmorei (Blyth, 1856, "1855") (FRIM 1155)

One individual was collected from alongside the logging road. This species was not observed at all during the 2002 surveys. No vocalizations of this species were noted. The specimen escaped before being photographed, tissued or preserved. This species was not observed during the 2002 survey.

Microhyla butleri Boulenger, 1900 (FRIM 1156)

Individuals of this species were observed vocalizing and collected from vegetation along-

FIGURE 7: Adult male *Pedostibes hosii* from along shores of Sungai Selaur.

FIGURE 8: *Megophrys aceras* from Skink trail.

FIGURE 9a: Gravis female *Rhacophorus* sp. found on dirt road.

FIGURE 9b: Adult male *Rhacophorus* sp. from floodplain.

side water-logged silt-traps alongside the logging road.

Microhyla heymonsi Vogt, 1911 (FRIM 1157-1158)

Large choruses of this species were noted around the logging camp and alongside the logging roads, with advertising activity taking place every night throughout the survey period.

Ranidae

Amolops larutensis (Boulenger, 1899) (FRIM 1159-1160)

This species was observed on boulders in and on the banks of Sg. Selaur.

Fejervarya aff. *limnocharis* (Gravenhorst, 1829) (FRIM 1159-1160)

This species was common around the logging camp, as well as on and alongside the logging roads. Vocalizations were noted on almost every evening, and amplexing pairs were observed in puddles in and around the logging camp.

Limnonectes blythii (Boulenger, 1920) (FRIM 1163-1164)

This species was observed along Sg. Selaur as well as on the banks of "Kuhlii Creek". In addition, individuals were occasionally encountered in the hill slope forest (e.g. along "Skink

FIGURE 10a: Dorsal view of adult male *Draco cristatellus* from along roadside near Sungai Selaur.

FIGURE 10b: Lateral view of head and dewlap of adult male from along roadside near Sungai Selaur.

Trail"). All the individuals encountered were of relatively small size (< 10 cm SVL).

Limnonectes kuhlii (Tschudi, 1838)

A single individual was observed in a sandy-bottomed midstream pool in "Kuhlii Creek". It was not collected.

Limnonectes laticeps (Boulenger, 1882)

Vocalizations of this species were noted from the forest adjacent to the Sg. Selaur floodplain. Specimens were not collected.

Limnonectes plicatellus (Stoliczka, 1873)

Vocalizations of this species were noted from water-logged areas behind the logging camp, as well as from swampy areas adjacent to "Kuhlii Creek". Specimens were not collected.

Rana laterimaculata Barbour & Noble, 1916

This species was not observed during the present survey, though it was observed in the 2002 survey (reported as "*Rana cf. baramica*": the work of Leong et al. (2003), has re-established *Rana laterimaculata* as a distinct species, and the individuals observed in this area in 2002 correspond to this species, as determined by their call).

Rana erythraea (Schlegel, 1837) (FRIM 1165)

This species was observed in the scrub vegetation surrounding a large standing body of water just off the logging road, as well as around water-logged areas near the logging camp.

Rana glandulosa Boulenger, 1882 (FRIM 1166)

Vocalizations of this species were noted throughout the survey period. They appeared to be concentrated around a large standing body of water just off the logging road, though a single individual was collected from the opposite side of the road, on the scrub-covered earth bank, not far from the water body.

FIGURE 11: Left: Brown phase of adult male *Gonocephalus abottii* from floodplain habitat. Middle: Green phase of adult male *Gonocephalus abottii* from floodplain habitat. Right: Black colour shift of green phase of *Gonocephalus abottii* from floodplain habitat.

Rana hosii Boulenger, 1891 (FRIM 1167-1168)

This species was common in and around the banks of Sg. Selaur. In addition, occasional individuals were encountered on the floodplain adjacent to the river. Vocalizations were noted on most evenings.

Rana nicobariensis (Stoliczka, 1870)

This species was noted vocalizing from the scrub vegetation surrounding a large standing body of water just off the logging road. This species was not observed during the 2002 survey. Specimens were not collected.

Rana nigrovittata (Blyth, 1856 "1855") (FRIM 1169-1170)

This species was observed vocalizing around the logging camp, generally (but not exclusively) concentrated around water-logged areas. Individuals were also encountered in water-logged silt-traps along side the logging roads.

Rana picturata Boulenger, 1920 (FRIM 1173)

Vocalizations of this species were noted along Sg. Selaur. An individual was collected from the edge of the logging road, a short distance from the river.

Rana raniceps (Peters, 1871) (FRIM 1171-1172)

This species was fairly common on the floodplains of Sg. Selaur, as well as perched on vegetation surrounding and overhanging water-logged silt-traps along side the logging road.

Taylorana hascheana (Stoliczka, 1870)

Vocalizations of this species were noted during the entire survey period, day and night, from throughout the forest (at all sites). No specimens were collected. No vocalizations of this species were observed at all during the 2002 survey.

Rhacophoridae

Nyctixalus pictus (Peters, 1871) (FRIM 1174)

Vocalizations of this species were noted from the Sg. Selaur floodplain, and a single individual was observed perched on low vegetation adjacent to "Kuhlii Creek".

FIGURE 12: Adult male *Aeluroscalabotes felinus* near floodplain habitat.

FIGURE 14: Juvenile *Varanus dumerilii* from roadside.

Philautus parvulus (Boulenger, 1893)

Vocalizations of this species were noted during the entire survey period from scattered locations throughout most of the sites surveyed. No specimens were collected during the present survey but were collected during the 2002 survey.

Polypedates leucomystax (Gravenhorst, 1829) (FRIM 1175-1177)

This species was observed and collected around the logging camp and along the logging roads near the camp.

Rhacophorus nigropalmatus Boulenger, 1895

This species was not observed at all during the present survey, in contrast to the large breeding aggregation noted during the first week of the 2002 survey.

Rhacophorus prominanus Smith, 1924 (FRIM 1178-1180)

This species was common around the logging camp, with active advertising taking place

FIGURE 13: *Sphenomorphus* cf. *butleri* from Gibbon trail.

on most nights. Individuals were perched on scrub vegetation and among piled-up debris remaining from forest-clearing at the edge of the logging camp, usually concentrated around water-logged soil.

Rhacophorus sp. (FRIM 1181-1182)

A large gravid female (Fig. 9) was found crouched in the interstices of truck tracks in the middle of a new logging road (N5.54035 E101.60670), at about 800 m, in the late afternoon on 20 August. There was no sign of any bodies of water or foam nests anywhere in the immediate vicinity. The road itself was significantly exposed to the sun, with no canopy cover. A male of the same species (Fig. 8) was collected from the crown (ca. 10 m above the forest floor) of a medium-sized tree standing in the Sg. Selaur floodplain the following evening. Both individuals do not correspond to any known form of rhacophorid previously documented in the Malay Peninsula. A preliminary analysis keyed out both specimens to *Rhacophorus harrissoni* Inger and Haile, thus far known only from Borneo, based on characters given in Inger (1966). Further analysis will be carried using appropriate comparative material to confirm or refine this identification.

Theloderma horridum (Boulenger, 1903) (FRIM 1183)

A single individual was collected from a water-filled cavity approximately 5 x 7 cm on the buttresses of a tree adjacent to "Kuhlii Creek".

AMPHIBIA (Caecilian)

Ichthyophis sp. (FRIM 1184)

A juvenile yellow-banded caecilian was collected from the edge of Sg. Selaur during the evening of 24 August while swimming in a

FIGURE 15: Adult *Trimeresurus sumatranus* from floodplain habitat.

small side pool. This species was not reported in the 2002 survey.

REPTILIA
SQUAMATA (LIZARDS)

A total of 17 species of lizards from five families were documented in the sites during the surveys, representing four species of gekkonids, one species of eublepharid, 10 species of agamid, 3 species of scincids, and one species of varanid.

Agamidae

Acanthosaura armata (Hardwicke and Gray, 1827) (FRIM 1185)

Three specimens were found at night sleeping on the sides of small trees 2–3 m above the forest floor. All were found in floodplain vegetation associated with Sg. Selaur.

Bronchocela cristatella (Kuhl, 1820) (FRIM 1186)

One adult female was found sleeping in the small branches of a large tree approximately 3 m above the forest floor in the flood plain area along Sg. Selaur on 30 August 2003.

Draco cristatellus Günther 1872 (FRIM 1187)

On 20 August 2003 one adult male (Figs. 10) was observed 5 m above the ground on the side of a large tree (0.6 m in diameter) along the side of the logging road where it crosses Sg. Selaur.

Draco fimbriatus Kuhl 1820

One specimen was observed on a large tree (ca. 1 m diameter) 4 m above the ground through binoculars. It was in hill mixed dipterocarp forest and was pursued for approximately 15 minutes before it climbed to height out of range of our blow pipes.

Draco formosus Boulenger 1900 (FRIM 1188-1192)

Adults and juveniles were observed throughout the study period on all sizes of trees from 2–8 m above the ground throughout the study area.

Draco maximus Boulenger 1893 (FRIM 1193-1197)

Five specimens were observed between 19 and 23 August. All were on large trees (ca. 1 m diameter) from 4–6 m above the forest floor. Some specimens were found in flood plain vegetation associated with Sg. Selaur and the others were found in either lowland or hill mixed dipterocarp forests.

Draco melanopogon Boulenger 1887 (FRIM 1198-1202)

Thirty–forty specimens were observed throughout the study period in all habitats. All were found on trees ranging from saplings to large dipterocarps (> 1 m diameter). Specimens were observed sitting from 2-10 m above the forest floor.

Draco quinquefasciata Hardwicke and Gray, 1927 (FRIM 1203-1206)

Several specimens were seehn throughout the study period. All were on small trees associated with floodplain vegetation along Sg. Selaur, small trees along Kuhlii Creek and hill mixed dipterocarp on the skink trail. All were between three and five meters above the forest floor.

Draco sumatranus Schlegel , 1844

No individuals of this species were observed during the present survey, but were reported in the previous survey of the immediate area (Sukumaran, 2002).

Gonocephalus abbotti Cochran 1922 (FRIM 1207-1209)

Three specimens of this rare lizard were found during the evening sleeping on the sides of trees in the flood plain associated with the Sg. Selaur. The first was a large female (SVL 162 mm) observed 3 m above the forest floor on the side of a large tree (ca. 0.7 m diameter) on 19 August. Prior to capture, the specimen was a nearly uniform lime green with a series of yellow paravertebral spots (Fig. 11). Shortly after capture, she turned a uniform black (Fig. 11). The second specimen was a juvenile female (SVL 110 mm) found on 20 August approximately 2.5 m above the ground on a small sapling. It too was green at the time of capture and turned to black afterwards. The third specimen was an adult male (SVL 163 mm) observed on 22 August 4 m above the ground on a large tree (ca. 0.7 m diameter). Prior to capture it color was brick red (Fig. 11) and darkened considerably after capture. Sukumaran (2002) reported finding a small red male collected while sleeping on a sapling in the same flood plain. These data indicate a color polymorphism where males are reddish and females are green.

Gonocephalus grandis (Gray, 1845) (FRIM 1210-1212)

Several specimens were observed at various heights in the vegetation along Sg. Selaur. Lizards were observed during the day on the sides of trees and at night sleeping on the ends of the branches near the water's edge. Juveniles, subadults and adults were observed. This species was observed reported by Sukumaran (2002) as well.

Eublepharidae

Aeluroscalabotes felinus (Günther, 1864) (FRIM 1213)

One adult male (Fig. 12) was observed on the evening of 21 August 3 m above the ground in a small tree in the flood plain along Sg. Selaur.

Gekkonidae

Cosymbotus craspedotes (Mocquard, 1890) (FRIM 1214)

One specimen was observed on 19 August 3 m above the ground on the side of a large three (ca. 1.5 m diameter) along the edge of the road.

Cyrtodactylus quadrivirgatus Taylor 1962 (FRIM 1215)

Specimens were observed throughout the study area at night on leaves 3–4 m above the ground. This species was reported by Sukumaran (2002) as well.

Gehyra mutilata (Wiegmann, 1834) (FRIM 1216)

During the evening of 23 August an adult female was collected off the side of a decomposing dipeterocarp while it was feeding on termites.

Ptychozoon kuhli (Stejneger, 1902) (FRIM 1217)

One adult female was collected from the bottom of a small tree (ca. 0.5 m diameter) on the evening of 19 August along the side of the road. Another was observed on a nearby tree of the same size and its tail was shot off with a blow pipe.

Scincidae

Dasia olivacea Gray 1839

Specimens were seen throughout the study period high up on large trees in mixed hill dipterocarp forest and trees along Sg. Selaur at the Orang Asli village approximately 1 km downstream from the logging camp. None were collected.

Eutropis multifasciatus (Kuhl, 1820) (FRIM 1218)

One juvenile was dug out of a hole along side the logging road on the evening of 19 August. Another juvenile was observed on 24 August at the Orang Asli village foraging through the roots at the base of a large tree.

Sphenomorphus cf. *butleri* (Boulenger, 1912) (FRIM 1219)

One specimen of this skink was seen foraging through the leaf litter in hill mixed dipterocarp forest on the evening of 20 August. It has the diagnostic characters of *Sphenomorphus* (Manthey and Grossmann, 1997) and conforms most closely to *S. butleri* known only from three syntypes (BM 1946.8.7–9; and examined herein) from Bukit Larut, approximately 220 km to the southwest. FRIM has 30 scale rows at midbody vs. 33 for *S. butler*i*;* 70 rows of paravertebral scales vs. 66 for *S. butleri*; 4 supraoculars like *S. butleri*; and 11 subdigital lamellae on the fourth toes vs. 11-12 for *S. butleri.* . FRIM xxx differs most from *S. butleri* in having a SVL of 26.4 mm vs. 34-44 mm in *S. butleri.* However, FRIM 1219 appears to be a subadult based on head-body proportions. Its color pattern closely matches that of *S. butleri* as well (Fig. 13). Until additional specimens are found, the identification remains tentative.

Varanidae

Varanus dumerilii (Schlegel, 1939)

A juvenile was observed during the afternoon of 19 August, sunning itself in the middle of the road. The specimen was photographed (Fig. 14) and released.

SQUAMATA (Snakes)

A total of four species of colubrid snakes were documented during the surveys. This is added to the single species of colubrid and viperid reported by Sukumaran (2002).

Colubridae

Boiga dendrophila (Boie, 1827) (FRIM 1220)

One subadult was observed in the branches of a small tree approximately 5 m above the ground along side the logging road in lowland mixed dipterocarp forest on the evening of 19 August. A large adult was found 3 m above the ground in the flood plain vegetation near Sg. Selaur during the evening of 24 Aug.

Lycodon subcinctus Boie 1827 (FRIM 1221)

On the evening of 19 August, one adult male (SVL 615 mm) was found crawling along side the edge of a logging road in lowland mixed dipterocarp forest. It had a partially digested adult *Gongylosoma* cf. *longicaudata* in its stomach (see below).

Gongylosoma cf. *longicauda* (Peters, 1872) (FRIM 1222)

A partially digested adult (SVL ca. 480 mm) *Gongylosoma* cf. *longicauda* was found in the stomach of an adult *Lycodon subcinctus.* The snake had been eaten head first and much of the skin and scales of the anterior 20% of the body had been partially digested. The remainder of the snake was intact. The specimen had smooth scales, 13 scale rows at midbody, a split anal plate, a yellow venter, a uniform olive-drab dorsum with a white chevron-shaped nuchal marking. The combination of these characteristics places it within the species *G. longicauda,* following Tweedie (1987). However, striping on the anterior of the body typical of this species (Tweedie, 1987) was unobservable. Thus, the identification is tentative.

TABLE 1: List of amphibian and reptile species found in the present survey and that of Sukumaran (2002) at the PITC logging concession in the Temengor Forest Reserve, Perak, West Malaysia.

	Species	Small Streams	Large Streams	Flood-plain	Hillslope Forest	Logging Roads or Camp	Other (see text for details)
	AMPHIBIANS (FROGS)						
	Bufonidae						
1	*Bufo asper* Gravenhorst, 1829		X			X	
2	*Bufo parvus* Boulenger, 1887	X					
3	*Leptophryne borbonica* (Tschudi, 1838)	X			X	X	
4	*Pedostibes hosii* (Boulenger, 1892)		X				
	Megophryidae						
5	*Leptolalax heteropus* (Boulenger, 1900)	X					
6	*Megophrys nasuta* (Schlegel, 1837)			X	X		
7	*Megophrys aceras* (Boulenger, 1903)				X		
	Microhylidae						
8	*Microhyla berdmorei* (Blyth, 1856, "1855")[*]					X	
9	*Microhyla butleri* Boulenger, 1900					X	
10	*Microhyla heymonsi* Vogt, 1911					X	X
	Ranidae						
11	*Amolops larutensis* (Boulenger, 1899)		X				
12	*Fejervarya* aff. *limnocharis* (Gravenhorst, 1829)					X	X
13	*Limnonectes blythii* (Boulenger, 1920)	X	X		X		
14	*Limnonectes kuhlii* (Tschudi, 1838)	X					
15	*Limnonectes laticeps* (Boulenger, 1882)			X			
16	*Limnonectes plicatellus* (Stoliczka, 1873)					X	X
17	*Rana erythraea* (Schlegel, 1837)[*]						X
18	*Rana glandulosa* Boulenger, 1882					X	X
19	*Rana hosii* Boulenger, 1891		X				
20	*Rana nicobariensis* (Stoliczka, 1870)						X
21	*Rana nigrovittata* (Blyth, 1856 "1855")					X	X
22	*Rana raniceps* (Peters, 1871)	X	X	X		X	X
23	*Rana signata* (Günther, 1872)		X			X	
24	*Taylorana hascheana* (Stoliczka, 1870)[*]				X		X
	Rhacophoridae						
25	*Nyctixalus pictus* (Peters, 1871)	X		X			
26	*Philautus parvulus* (Boulenger, 1893)				X		
27	*Polypedates leucomystax* (Gravenhorst, 1829)					X	X
28	*Rhacophorus prominanus* Smith, 1924						X
29	*Rhacophorus* sp.[*]			X		X	

	Species	Small Streams	Large Streams	Flood-plain	Hillslope Forest	Logging Roads or Camp	Other (see text for details)
30	*Theloderma horridum* (Boulenger, 1903)*	X					
AMPHIBIANS (Caecilians)							
Ichthyophidae							
1	*Ichthyophis* sp.*		X				
REPTILES (Lizards)							
Agamidae							
1	*Acanthasaura armata* (Hardwicke and Gray, 1827)			X			
2	*Bronchocela cristatella* (Kuhl, 1820)			X			
3	*Draco cristatellus* Günther, 1872*					X	
4	*Draco fimbriatus* Kuhl, 1820*					X	
5	*Draco formosus* Boulenger 1900	X		X	X	X	
6	*Draco maximus* Boulenger, 1893			X	X	X	
7	*Draco melanopogon* Boulenger, 1893	X		X	X	X	
8	*Draco quinquefasciatus* Hardwicke and Gray, 1927	X		X	X		
9	*Gonocephalus abbotti* Cochran 1922			X			
10	*Gonocephalus grandis* (Gray, 1845)		X				
Eublepharidae							
1	*Aeluroscalabotes felinus* (Günther, 1864)*			X			
Gekkonidae							
1	*Cosymbotus craspedotus* (Mocquard, 1890)*					X	
2	*Cyrtodactylus quadrivirgatus* Taylor, 1962	X	X	X	X		
3	*Gehyra mutilata* (Wiegmann, 1834)*					X	
4	*Ptychozoon kuhli* Stejneger, 1809*					X	
Scincidae							
1	*Dasia olivacea* Gray, 1839			X		X	
2	*Eutropis multifasciatus* (Kuhl, 1820)			X		X	
3	*Sphenomorphus* cf. *butleri* (Boulenger, 1912)				X		
Scincidae							
1	*Varanus dumerilii* (Schlegel, 1839)*					X	
REPTILES (Snakes)							
Colubridae							
1	*Boiga dendrophila* (Boie, 1827)			X		X	
2	*Lycodon subcinctus* Boie, 1827*					X	
3	*Gongylosoma* cf. *longicauda* (Peters, 1871)						X
4	*Xenochrophis trianguligerus* (Boie, 1827)*		X			X	

TABLE 2: List of amphibian and reptile species known from the Temengor-Belum region.

	Species	Kiew et al. 1995	Diong et al. 1995	Lim et al. 1995a	Lim et al. 1995b	Nor-sham et al. 2000	Suku-maran 2002	Pres-ent Survey
AMPHIBIANS (Anurans)								
Bufonidae								
1	*Bufo asper* Gravenhorst, 1829	X				X	X	X
2	*Bufo parvus* Boulenger, 1887	X				X	X	X
3	*Leptophryne borbonica* (Tschudi, 1838)						X	X
4	*Pedostibes hosii* (Boulenger, 1892)					X	X	X
Megophryidae								
5	*Leptobrachium hendricksoni* Taylor, 1962	X						
6	*Leptolalax heteropus* (Boulenger, 1900)	X					X	X
7	*Megophrys nasuta* (Schlegel, 1837)	X					X	X
8	*Megophrys aceras* (Boulenger, 1903)						X	X
Microhylidae								
9	*Kalophrynus pleurostigma* Tschudi, 1838	X						
12	*Microhyla berdmorei* (Blyth, 1856, "1855")							X
11	*Microhyla butleri* Boulenger, 1900						X	X
12	*Microhyla heymonsi* Vogt, 1911	X					X	X
Ranidae								
13	*Amolops larutensis* (Boulenger, 1899)	X				X	X	X
14	*Fejervarya* aff. *limnocharis* (Gravenhorst, 1829)	X				X	X	X
15	*Limnonectes blythii* (Boulenger, 1920)	X				X	X	X
16	*Limnonectes kuhlii* (Tschudi, 1838)	X					X	X
17	*Limnonectes laticeps* (Boulenger, 1882)	X					X	X
18	*Limnonectes paramacrodon* (Inger, 1966)					X		
19	*Limnonectes plicatellus* (Stoliczka, 1873)						X	X
20	*Occidozyga laevis* (Günther, 1859 "1858")	X						
21	*Rana laterimaculata* Barbour and Noble, 1916						X	
22	*Rana erythraea* (Schlegel, 1837)	X				X		X
23	*Rana glandulosa* Boulenger, 1882	X					X	X
24	*Rana hosii* Boulenger, 1891	X				X	X	X
25	*Rana nicobariensis* (Stoliczka, 1870)							X
26	*Rana nigrovittata* (Blyth, 1856 "1855")	X					X	X
27	*Rana raniceps* (Peters, 1871)	X					X	X
28	*Rana signata* (Günther, 1872)	X					X	X
29	*Taylorana hascheana* (Stoliczka, 1870)							X
Rhacophoridae								
30	*Nyctixalus pictus* (Peters, 1871)						X	X

	Species	Kiew et al. 1995	Diong et al. 1995	Lim et al. 1995a	Lim et al. 1995b	Nor-sham et al. 2000	Suku-maran 2002	Pres-ent Survey
31	*Philautus parvulus* (Boulenger, 1893)						X	X
32	*Philautus petersi* (Boulenger, 1900)	X						
33	*Polypedates leucomystax* (Gravenhorst, 1829)						X	X
34	*Polypedates macrotis* (Boulenger, 1891)	X						
35	*Rhacophorus nigropalmatus* Boulenger, 1895						X	
36	*Rhacophorus prominanus* Smith, 1924	X					X	X
37	*Rhacophorus* sp.							X
38	*Theloderma horridum* (Boulenger, 1903)							X
AMPHIBIANS (Caecilians)								
Ichthyophidae								
39	*Ichthyophis* sp.							X
REPTILES (Turtles)								
Emydidae								
40	*Callagur borneoensis* (Schlegel and Müller, 1844)				X			
41	*Cuora amboinensis* (Daudin, 1802)				X			
42	*Cyclemys dentata* (Gray, 1831)				X			
43	*Heosemys spinosa* (Gray, 1831)				X			
44	*Notochelys platynota* (Gray, 1834)				X			
Trionychidae								
45	*Amyda cartilaginea* (Boddaert, 1770)				X			
46	*Dogania subplana* (Geoffroy, 1809)				X			
REPTILES (Lizards)								
Agamidae								
47	*Aphaniotis fusca* Peters, 1864		X					
48	*Acanthosaura armata* (Hardwicke and Gray, 1827)		X					X
49	*Bronchocela cristatella* (Kuhl, 1820)		X					X
50	*Calotes emma* Gray, 1845		X					
51	*Draco cristatellus* Günther, 1872							X
52	*Draco fimbriatus* Kuhl, 1820							X
53	*Draco formosus* Boulenger, 1900							
54	*Draco maximus* Boulenger, 1893		X					X
55	*Draco melanopogon* Boulenger, 1893		X				X	X
56	*Draco quinquefasciatus* Hardwicke and Gray, 1927		X					X
57	*Draco sumatranus* Schlegel, 1844		X				X	
58	*Gonocephalus abbotti* Cochran 1922		X				X	X
59	*Gonocephalus belli* (Duméril and Bibron, 1837)		X					
60	*Gonocephalus grandis* (Gray, 1845)		X				X	X
Eublepharidae								
61	*Aeluroscalabotes felinus* (Günther, 1864)							X

	Species	Kiew et al. 1995	Diong et al. 1995	Lim et al. 1995a	Lim et al. 1995b	Nor-sham et al. 2000	Suku-maran 2002	Pres-ent Survey
Gekkonidae								
62	*Cosymbotus craspedotus* (Mocquard, 1890)							X
63	*Cyrtodactylus consubrinus* (Peters, 1871)		X					
64	*Cyrtodactylus quadrivirgatus* Taylor, 1962		X					X
65	*Gekko smithii* Gray, 1842		X					
66	*Gehyra mutilata* (Wiegmann, 1834)							X
67	*Ptychozoon horsfieldi* (Gray, 1827)		X					
68	*Ptychozoon kuhlii* Stejneger, 1809							X
Scincidae								
69	*Dasia olivacea* Gray, 1839		X					X
70	*Eutropis multifasciatus* (Kuhl, 1820)		X					X
71	*Sphenomorphus maculatus* (Blyth, 1854)		X					
72	*Sphenomorphus* cf. *butleri* (Boulenger, 1912).							X
Varanidae								
73	*Varanus dumerilii* (Schlegel, 1839)							X
74	*Varanus rudicollis* (Gray, 1845)		X					
75	*Varanus salvator* (Laurenti, 1768)		X					
REPTILES (Snakes)								
Typhlopidae								
76	*Ramphotyphlops lineatus* (Schlegel, 1839)			X				
Pythonidae								
77	*Python brongersmai* Stull, 1938			X				
78	*Python reticulatus* (Schneider, 1801)			X				
Colubridae								
79	*Ahaetulla prasina* (Boie, 1827)			X				
80	*Aplopeltura boa* (Boie, 1828)						X	
81	*Boiga cynodon* (Boie, 1827)			X				
82	*Boiga dendrophila* (Boie, 1827)			X				X
83	*Dendrelaphis formosus* (Boie, 1827)			X				
84	*Elaphe flavolineata* (Schlegel, 1837)			X				
85	*Elaphe prasina* (Blyth, 1854)			X				
86	*Enhydris indica* (Gray, 1842)			X				
87	*Gongylosoma* cf. *longicauda* (Peters, 1871)							X
88	*Gonyosoma oxycephalum* (Boie, 1827)			X				
89	*Lepturophis albofuscus* (Duméril, Bibron, Duméril, 1854)			X				
90	*Lycodon subcintus* Boie, 1827							X
91	*Oligodon purpurescens* (Schlegel, 1837)			X				
92	*Oreocalamus hanitschi* Boulenger, 1899			X				

	Species	Kiew et al. 1995	Diong et al. 1995	Lim et al. 1995a	Lim et al. 1995b	Norsham et al. 2000	Sukumaran 2002	Present Survey
93	*Psammodynastes pulvurulentus* (Boie, 1827)			X				
94	*Pseudorhabdion longiceps* (Günther, 1896)			X				
95	*Xenochrophis trianguligerus* (Boie, 1827)							X
Elapidae								
96	*Bungarus candidus* (Linnaeus, 1758)			X				
97	*Calliophis bivirgata* (Boie, 1827)			X				
98	*Naja sumatrana* (Müller, 1890)			X				
Colubridae								
99	*Trimeresurus hageni* (Lidth de Jeude, 1886)			X				
100	*Trimeresurus popeiorum* Smith, 1837			X				
101	*Trimeresurus sumatranus* (Raffles, 1822)						X[1]	
102	*Tropidolaemus wagleri* Wagler, 1839			X				

[1] Erroneously reported as *Tropidolaemus wagleri* by Sukumaran (2002), but identified in the current paper as *Trimeresurus sumatranus* based on photographs. See text for details.

Xenochrophis trianguligerus (Boie 1827) (FRIM 1223)

One specimen was seen crossing the logging road in the afternoon in lowland mixed dipterocarp forest which escaped capture. Another was collected at the edge of a small pond along the flood plain of Sg. Selaur on the evening of 21 August.

Aplopeltura boa (Boie, 1827)

This species was not observed during the current survey. It was noted in the 2002 survey, perched on a vine about 2 m above the ground on the Sg. Selaur floodplain (Sukumaran, pers. observ.).

Viperidae

Trimeresurus sumatranus (Raffles, 1822)

This species was not observed during the present survey, though a large individual was documented in the area during the 2002 survey, resting about 1.5 m above the ground in the middle of a rattan thicket on the Sg. Selaur floodplain. It was reported as *Tropidolaemus wagleri* (Sukumaran, 2002). However examination of the voucher photographs (cat. nos.; Fig. 15) show it to be *T. sumatranus*.

DISCUSSION

Between 1993-1994, the Malaysian Nature Society carried out a biodiversity expedition in the Temengor forest, with surveys concentrated approximately 20-25 km to the east of the present study (Fig. 1). They identified 24 species of amphibians (Kiew et al., 1995), six species of turtles (Lim et al., 1995b), 21 species of lizards (Diong et al., 1995) and 23 species of snakes (Lim et al., 1995a). The present survey has added six species to the amphibian fauna of the immediate area (Anura: *Microhyla berdmorei*, *Rana nicobariensis*, *Rhacophorus* sp., *Taylorana hascheana*, *Theloderma horridum*; Gymnophiona: *Ichthyophis* sp.), eight species of lizards (*Draco cristatellus, Draco fimbriatus, Aeluroscalabotes felinus, Cosymbotus craspedotus, Gehyra mutilata, Ptychozoon kuhli* and *Sphenomorphus* cf. *butleri*), and four species of snakes (*Lycodon subcinctus, Gongylosoma* cf. *longicaudata* and *Xenochrophis trianguligerus*) to the general inventory of the Temengor ForestReserve.

This brings the total number of anurans documented in the immediate PITC area to 31. The addition of *Limnonectes paramacrodon* as documented by Norsham et al. (2000) brings the total number of anuran species documented in

Temengor to 32, while, when considering the general Belum-Temengor area as a whole, the total number of anuran species documented is 38.

Two species noted by Sukumaran (2002), *Rhacophorus nigropalmatus* and *Rana laterimaculata*, were not observed during the present survey. This can attributed to the difficulty of observing these species due to weather and seasonality. *Rhacophorus nigropalmatus* is usually only observable when they descend from the canopy to form breeding aggregations. It is an explosive breeder with its primary reproductive season being the opening weeks of the rainy season. For the remainder of the year it is cryptic. The 2002 survey coincided with the primary monsoon, while the present survey did not. Similarly, the loud, distinctive calls of *Rana laterimaculata* make its presence in an area easy to detect, but they often remain cryptic otherwise. The relative dryness of the current survey period may have led to decreased (or even cessation of) advertising activity.

This survey adds 12 species of reptiles to the immediate area not discussed previously by Diong et al (1995), Lim et al. (1995a, b) and Sukumaran (2002). This is likely an under representation of the species that occur in this area in that many species generally have well-developed cryptic capabilities. Noticeably absent are species of fossorial/semi-fossorial snakes such as *Calamaria*, *Pseudorhabdion,* etc. A comprehensive list of all the herpetofauna of the Temengor-Belum region is presented in Table 2.

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ADDENDA

The site was revisited by the authors in September of 2005, for a follow-up survey, a period of time that corresponded approximately the same season and weather conditions of the survey reported in the main body of this paper. No new frog or lizard species were documented at the site during the 3-day/2-night survey period. However, two new snake species were documented: *Gonyosoma oxycephalum*, found about a meter and a half up and coiled around the bole of a small tree at the edge of a river, next to an Orang Asli settlement; and *Zaocys carinatus*, found on the banks of the main logging road.

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NOTES ON A COLLECTION OF AMPHIBIANS AND REPTILES FROM SOUTHERN LAOS, WITH A DISCUSSION OF THE OCCURRENCE OF INDO-MALAYAN SPECIES

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(with eight text-figures)

ABSTRACT.– Investigations of herpetological biodiversity were conducted at two adjacent localities of southern Laos. Our surveys focused on the Boloven Highlands and the adjacent lowland area of Xepian National Biodiversity and Conservation Area. A preliminary list of 75 species (22 amphibians, 1 chelonian, 25 lizards, and 27 snakes) is established, of which two are undescribed, and 17 are new records for Lao PDR (five amphibians, 12 reptiles), including a snake species collected in Vientiane. Two species recorded from southern Laos belong to the Indo-Malayan fauna (*Kaloula baleata* and *Gonocephalus grandis*). A brief comparison is made with other areas of South-east Asia.

KEYWORDS.– Amphibia, Reptilia, Laos, Boloven Highlands, Xepian National Biodiversity and Conservation Area.

INTRODUCTION

The herpetofauna of the Lao Popular Democratic Republic (hereafter merely referred to as Laos) probably ranks among the least known in mainland South-east Asia. Although Angel (1929), Bourret (1934, 1936a-b, 1939, 1942) and especially Deuve (1961a-b, 1962, 1963, 1970 [non-exhaustive list]) published specialized or general reviews of the herpetofauna of this country, very few regions have been subject to detailed reports on their herpetofauna prior to Stuart (1999). Most recent investigations bear either on Upper Laos or on the lowlands of Central Laos, or on mountain tracts of the Annamite Range.

In this paper, we describe a collection of amphibians and reptiles of southern Laos obtained during a short stay in May-June 2003 by Alexandre Teynié and the team of the Association "Société d'Histoire Naturelle Alcide d'Orbigny", and during a visit by Thomas Calame and Benjamin Calmont, of the same team, in November-December 2003. Specimens were obtained from two adjacent areas of Champasak Province, selected as representatives of the lowland and montane herpetofaunas respectively. For the lowland fauna, we investigated mainly the vicinity of Ban Kiatngong (14° 34'N; 106° 12'E), Pathomphon District, a village located between 90 et 300 m a.s.l. in Xepian National Biodivervisity and Conservation Area (hereafter referred to as Xepian NBCA) between 24 and 30 May, and between 24 November and 4 December. During this latter trip, collections were also made at Ban Taong, Xepian NBCA (14° 18'N; 106° 22'E), at elevations between 150 and 250 m asl.

Our efforts in the montane fauna were aimed at Ban Sepian, Paksong District, at 1200-1250 m a.s.l. in Boloven Highlands (15° 08'N; 106° 16'E; referred herafter as Sepian, Boloven Highlands), investigated from 1 to 7 June 2003. This

montain range has seemingly been neglected by herpetologists but is possibly of great biogeographical importance due to its isolated position between the plateaus of eastern Thailand and Cambodia and the Annamite Range. Some specimens collected in Vientiane, Pakse and Si Phan Don (The Four Thousand Islands) are also mentioned.

Xepian NBCA can be described as a region of lowland monsoon evergreen and lowland monsoon semi-evergreen forests (Collins et al., 1991), although some parts of the region are covered with open dry monsoon forest or have been converted to agricultural activities. Much of the vegetation of the park is composed of moist mixed deciduous forest (88%) and dry mixed deciduous forest (about 11%). This protected area, which was established in 1993, spans over 240.000 ha and lies between about 90 and 450 m a.s.l. It is situated at the extreme south of Laos, near the border with Cambodia, covering parts of the provinces of Champasak and Attapu (or Attapeu).

The Boloven Highlands, or Boloven Plateau (sometimes spelt as Bolaven, from Lao *Phu Phieng Bolaven*) are a broadly circular isolated basaltic montain range 20 km to the east of Pakse, spanning over the provinces of Attapu, Champasak, Sekong and a small part of Salavan. It is regarded as an outlier of the Annamite Range. Its easternmost slopes are separated from the western foothills of the Annamite Range by the valley of the Kong River, which is 20 km wide at its narrowest point. This plateau has a mean elevation of approximately 1050 m and a maximum of 1716 m a.s.l. It is directly in the path of south-west monsoon rains and receives more than 4,000 mm of rain per year, one of the highest amounts in Laos. The main vegetation of the Boloven Highlands is montane rainforests and monsoon evergreen forests. Mixed broadleaf (*Quercus*, *Dipterocarpus*) and coniferous forests (genus *Podocarpus*) are widespread. However, the plateau, due to its fertile soil, is heavily cultivated to the north of Pakse and largely dissected by plantations of coffee, bananas, durians, cabages, potatoes, maize, tomatoes and other crops). Some savannahs are also present. Slash-and-burn cultivation is largely used south-east of Paksong.

MATERIAL AND METHODS

The following list is based on preserved specimens for most species, although sight records were considered to be suitable for common, unquestionable species. No locally protected species were collected by the authors in the course of this study. Most specimens were photographed in life or freshly killed. Interesting specimens are described in detail. New records for Laos are preceded by an asterisk (*) in bold. Their status of new record for the country is derived from the list provided by Stuart (1999). Biological notes are exclusively based on our own field data and not on the literature.

Measurements, except body and tail lengths of reptiles, were taken with a slide-caliper to the nearest 0.1 mm; measurements of the body (all in millimetres) were taken to the nearest millimetre. Ventral scales were counted according to Dowling (1951). The terminal scute is excluded from the number of subcaudals. The number of dorsal scale rows at midbody is counted at the level of the ventral plate corresponding to half of the total ventral number. Values for symmetric head characters are given in left/right order.

Abbreviations. Measurements and morphometry. - SVL: Snout-vent length; TaL: Tail length; TaL/TL: ratio tail length/total length; TL: total length.

Scalation characters. – C3SL: number of scale(s) separating the 3rd SL from the subocular; C4SL: number of scale(s) separating the 4th SL from the subocular (left/right); Cep: number of cephalic scales on the shortest line separating the middle of supraoculars; DSR: dorsal scale rows; IL: infralabials; MSR: number of dorsal scale rows at midbody; SC: subcaudals; SL: supralabials; VEN: ventrals; Tem: temporals.

Museum abbreviations. – BMNH: The Natural History Museum, London; FMNH: Field Museum of Natural History, Chicago; MNHN: Muséum National d'Histoire Naturelle, Paris.

TAXONOMY

Amphibia

Anura

Bufonidae Gray, 1825

Bufo melanostictus (Schneider, 1799)

Material examined. – Several specimens from the following localities: Ventiane,Ventiane Province; Sepian, Boloven highlands, Champasak Province, not preserved but photographed; other observed specimens: Ban Kiatngong and Xepian NBCA, both in Champasak Province.

Biology. – A common species, observed in various habitats, including in forest. Some melanistic or submelanistic specimens were seen around ponds on dark volcanic soils. Amplexus was photographed in Vientiane Province on 24 November.

Megophryidae Bonaparte, 1850

* *Leptobrachium* sp.

Material examined. – MNHN 2003.1167 (adult female; SVL 49.8 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This specimen and another adult, not collected, were discovered in two different places under stones in disturbed areas, a road embankment and a grassfield in a pine plantation respectively. One specimen moved backwards at surprisingly high speed into its burrow. The members of this genus usually live in forests and reproduce in small streams.

Note. – This specimen belongs to a new species and will be described in another paper (Ohler et al., in prep.) Stuart (1999) recorded *Leptobrachium pullum* from the Annamite Foothills of Centre Laos and *Leptobrachium banae* Lathrop et al., 1998 from southern Laos.

Microhylidae Günther, 1858

Glyphoglossus molossus Günther, 1859

Material examined. – MNHN 2003.1168 (adult male), Pakse market, Champasak Province.

Biology. – This specimen was sold in the market among numerous specimens of the *Fejervarya limnocharis* group.

* *Kalophrynus interlineatus* (Blyth, 1855)

Material examined. – MNHN 2003.1169 (adult female; SVL 38.0 mm), Xepian NBCA, Champasak Province.

Biology. – This species was common in two localities, where it was observed on dark volcanic soil near a pond.

Note. – *Kalophrynus interlineatus* was not mentioned by Stuart (1999). It is otherwise known from southern Cambodia, China, Myanmar, Thailand and Vietnam. *Kalophrynus* are explosive breeders (Ohler, personal observation), being typically rather numerous but usually rare in collections.

* *Kaloula baleata* (Müller, 1836)

Material examined. – MNHN 2003.1170 (juvenile; SVL 30.7 mm), Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Collected near the mouth of a stream leading into Kiatngong marsh.

Note. – This species was previously known only from South Thailand and West Malaysia, its northernmost locality being Phangnga Province (Pauwels et al., 2000). The discovery of this Indo-Malayan species in southern Laos extends its range by more than 1000 airline kilometers, but its distribution might be discontinuous due to the lack of suitable habitats and favourable climatic conditions in most of Thailand and Cambodia.

Kaloula pulchra Gray, 1831

Material examined. – Several specimens, Pakse, vicinity of the stadium, Champasak Province.

Biology. – These specimens were seen in flooded ditches around the stadium built in an urbanized area with, between human dwellings, wet lawns used occasionnally as cow pastures. Several specimens were observed and / or identified by their call, a loud, sharp "honk" during a heavy rainshower at night.

Microhyla berdmorei (Blyth, 1856)

Material examined. – MNHN 2003.1171 (adult female; SVL 39.4 mm), MNHN 2003.1172 (adult male; SVL 31.7 mm), MNHN 2003.1173

(adult male; SVL 36.0 mm), Xepian NBCA, Champasak Province.

Biology. – Specimen MNHN 2003.1171 was collected in the forest on the bank of Huay Say (Say Stream). Specimen MNHN 2003.1173 was obtained near the mouth of a stream leading into Kiatngong marsh.

Microhyla butleri Boulenger, 1900

Material examined. – MNHN 2003.1174-1175 (adult males; both SVL 18.1 mm), between Phu San [Mt. San] and Phu Say [Mt. Say], Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Collected by day under a stump near a forest pond.

Ranidae Raffinesque-Schmaltz, 1814

Chirixalus doriae Boulenger, 1893

Material examined. – MNHN 2003.1176 (adult male ? [poorly preserved]; SVL 18.4 mm), Nong Him Kao, Boloven Highlands, Champasak Province.

Biology. – Collected on a short tree on the bank of a small river.

Chirixalus nongkhorensis (Cochran, 1927)

Material examined. – MNHN 2003.1194 (adult female; SVL 36.1 mm), Xepian NBCA, Champasak Province.

Biology. – The specimen was collected by day on a spawn glued at about two meters above the ground under a broad leaf of a tree growing on the bank of a pond. Such a behaviour has been observed in *Chirixalus vittatus* (Boulenger, 1887) (Ohler, unpublished observation) and in treefrogs from Africa (Amiet, 1991) where it has been interpreted to be parental care behaviour. The present specimen was displaced and carried on its branch for more than half an hour, without changing its position on the spawn, even when it was disturbed by sunshine or ants.

Note. – This specimen is very similar in size and color pattern to the specimen No. 1076 figured by Taylor (1962: 532).

Fejervarya limnocharis group

Material examined. – MNHN 2003.1177 (adult female; SVL 36.9 mm), Xepian NBCA, Champasak Province. - MNHN 2003.1179 (adult female; SVL 46.5 mm), Sepian, Boloven Highlands, Champasak Province. - MNHN 2003.1178 (juvenile; SVL 37.8 mm), near Kiatngong, Xepian NBCA, Champasak Province. - MNHN 2003.1197 (juvenile female; SVL 49.1 mm), Pakse market, Champasak Province.

Biology. – Common in various types of waterbodies, such as ponds, flooded ricefields and grassfields and marshes.

Note. – The systematics of this genus is very complicated because of the great similarity of recognized species (Dubois and Ohler, 2000). As no revision of this group is available for the Indochinese Region, no specific allocation can be made.

Limnonectes sp.

Material examined. – MNHN 2003.1180 (adult male? SVL 33.9 mm), Nong Him Kao, Boloven Highlands, Champasak Province. - MNHN 2003.1181 (juvenile female; SVL 29.4 mm), near Kiatngong, Xepian NBCA, Champasak Province.

Biology. – These specimens were collected by day.

Polypedates leucomystax group

Material examined. – Several specimens (not preserved), Xepian NBCA, Champasak Province; several specimens, not preserved, Sepian, Boloven Highlands, Champasak Province; one specimen (not preserved), Pakse, vicinity of the stadium, Champasak Province.

Biology. – Often collected at night in various habitats. The specimen from Paksé was collected at night on the bank of a ditch near the stadium, in the same conditions as *Kaloula pulchra*. In Kiatngong, many specimens were observed, most commonly perched at night on branches at 3-4 m above the ground near forest edges. Specimens from Sepian were often found close to streams and in the same habitats than in Kiatngong.

Note. – Until taxonomic revision including specimens from the whole of its large range has been conducted, specific allocation of population of this group will not be possible.

* *Philautus gryllus* Smith, 1924

Material examined. – MNHN 2003.1182 (adult male; SVL 18.9 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – A single specimen was collected at night at more than five meters above the ground at the edge of a forest.

Note. – This species was not mentioned by Stuart (1999). It is otherwise known from Vietnam.

* *Philautus odontotarsus* Ye & Fei, 1993

Material examined. – MNHN 2003.1183 (adult female; SVL 36.5 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This species is common in various habitats. Specimens were observed during the night, usually located by their song, perched on trunks and branches between 2 and 5 m above the ground, either along banks of streams or in cultivated areas, especially around burned fields or near human dwellings.

Note. – This species belongs to a group of rhacophorine frogs that includes various nominal species which need revision (Ohler et al., 2002). Specimens belonging to this group were mentioned by Stuart (1999) as *Rhacophorus baliogaster* Inger et al., 1999. Pending for revision we apply the first available name. Frogs of this species are otherwise known from southern China and Vietnam.

Phrynoglossus martensii Peters, 1867

Material examined. – MNHN 2003.1184 (adult male; SVL 22.7 mm), Xepian NBCA, Champasak Province. - MNHN 2003.1185 (juvenile male; SVL 19.9 mm), MNHN 2003.1186 (juvenile male; SVL 20.8 mm), between Phu San [Mt. San] and Phu Say [Mt. Say], Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Fairly common in various habitats. Our specimens were seen in open areas, such as in flooded ditches, ponds and marshes. Some were trapped in a well, others were observed in small forest ponds, on rocky or loose soils usually poorly covered in vegetation.

Note. – The genus *Phrynoglossus* also needs systematic revision (Stuart 1999). The specimen from Xepian NBCA has been allocated to *Phrynoglossus martensii* as it does not show the large warts and horny spinules present in some populations from Thailand, Laos and China which have been described in *Phrynoglossus magnapustulosus* (Taylor & Elbel, 1958). *P. martensii* is otherwise known from Thailand, southern China, Cambodia and Vietnam.

Rana erythraea (Schlegel, 1837)

Material examined. – MNHN 2003.1187 (adult female; SVL 46.4 mm), plus several not preserved specimens, Xepian NBCA, Champasak Province.

Biology. – Abundant, both by day and night, near a marsh, often perched on bushes and bamboos up to 2.5 m above the ground.

Note. – This specimen is smaller than adult females mentioned by Ohler and Mallick (2002) but it clearly belongs to *Rana erythraea* on the basis of its external morphology.

Rana macrodactyla (Günther, 1859)

Material examined. – MNHN 2003.1188 (adult female; SVL 35.5 mm), Xepian NBCA, Champasak Province.

Biology. – Abundant at night in the vicinity of a marsh.

* *Rana morafkai* Bain, Lathrop, Murphy, Orlov & Ho, 2003

Material examined. – MNHN 2003.1189-1190 (adult males; SVL 35.9 mm and SVL 42.8 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – Collected at night in a grassland bordering a stream at the edge of a forest.

Note. – This species was previously known only from its type locality, the Tay Nguyen Plateau of Vietnam's Central Highlands (Bain et al., 2003).

Rana nigrovittata (Blyth, 1855)

Material examined. – MNHN 2003.1191-1192 (both juveniles; SVL 27.1 mm and 27.4 mm), Xepian NBCA, Champasak Province.

Biology. – This species was obtained by day at the edge of a forest bordering a marshland.

Rana taipehensis Van Denburgh, 1909

Material examined. – MNHN 2003.1193 (adult female; SVL 44.2 mm), Xepian NBCA, Champasak Province.

Biology. – Collected at night in the low vegetation bordering a marshland.

Note. – This female is slightly larger than specimens allocated to *Rana taipehensis* by Ohler and Mallick (2002).

Gymnophiona

Ichthyophiidae Taylor, 1968

Ichthyophis cf. *kohtaoensis* (Taylor, 1960)

Material examined. – MNHN 2003.1195 (TL 252 mm), Sepian, Boloven Highlands, Champasak Province. - MNHN 2003.1196 (juvenile; TL 141 mm), Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Specimen MNHN 2003.1195 was found during day time under a stone in a coffee plantation at the edge of a forest. The other animal was discovered under a board in a disturbed forest.

Note. – Our specimens are morphologically similar to the animal depicted in Stuart (1999: 44, Pl. 8), from the Annamite Mountains of Central Laos. For many years, the name *Ichthyophis glutinosus* (Linnaeus, 1758) has been used for southeast Asian specimens of *Ichtyophis* Fitzinger, 1826 with a brown body color and yellow lateral stripe. This name is now only applied to South Indian populations. There is no consensus on the taxonomy of Indochinese *Ichthyophis*. Gower et al. (2002) conducted molecular studies that included various populations from Southeast Asia and found minor genetic differentiation between populations. The specific allocation of striped *Ichthyophis* awaits a generic revision.

REPTILIA

Chelonii

Trionychidae Fitzinger, 1826

Amyda cartilaginea (Boddaert, 1770)

Material examined. – 1 specimen (juvenile; subsequently released; TL 142 mm), near Pakse, Champasak Province.

Biology. – Collected in a fish breeding pond, near a canal in a disturbed area.

Lacertilia

Gekkonidae Gray, 1825

Cosymbotus platyurus (Schneider, 1797)

Material examined. – MNHN 2003.3369 (female; SVL 58 mm, TaL 41 mm), Pakse, vicinity of the stadium, Champasak Province. - 1 specimen (photographed only), Vientiane, Vientiane Prefecture.

Biology. – Collected active by day on the wall of a gas station.

* *Cyrtodactylus* sp.

Material examined. – MNHN 2003.3301 (juvenile male; SVL 33.3 mm, Tal 30.6 mm), northwest of Kiatngong, Xepian NBCA, Champasak Province.

Biology. – This animal was collected under a stone on the ground of an evergreen forest.

Note. – This specimen belongs to a new species that is being described in a separate paper (David et al., submitted.)

Dixonius siamensis (Boulenger, 1898)

Material examined. – MNHN 2003.3323 (sex unknown, tail truncated; SVL 35 mm), MNHN 2003.3324 (male; SVL 35 mm, tail truncated), MNHN 2003.3325 (sex unknown; SVL 34 mm), Xepian NBCA, Champasak Province. - MNHN 2003.3326 (sex unknown, tail truncated; SVL 40 mm), near Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Common in primary and secondary forests, under stones and decayed vegetation, sometimes in disturbed areas. Specimen MNHN 2003.3326 was collected under a stone in a forest.

Note. – Cited by Stuart (1999) as *Phyllodactyllus siamensis*.

Gekko gecko (Linnaeus, 1758)

Material examined. – 3 specimens (not preserved), Xepian NBCA, Champasak Province. - 1 specimen (photographed), Vientiane, Vientiane Prefecture.

Biology. – Xepian specimens were observed at night on a large tree trunk at the edge of a for-

est. No vocalization was head during the period of investigation.

Hemidactylus frenatus Duméril & Bibron, 1836

Material examined. – Several specimens (not preserved), Pakse, vicinity of the stadium, Champasak Province. - Several specimens (not preserved), Vientiane, Vientiane Prefecture.

Biology. – This species, active by day and night, is very common on human dwellings.

Agamidae Spix, 1825

Acanthosaura lepidogaster (Cuvier, 1829)

Material examined. – MNHN 2003.3312 (male; SVL 80 mm, TaL 111 mm), Xepian NBCA, Champasak Province.

Biology. – This specimen was collected in the afternoon in a forest.

Note. – This specimen has dark colored throat and neck and a barely visible diamond-shaped black mark on the nape. Among the specimens deposited in the collections of the MNHN, we found this condition only in a male (MNHN 1997.4353) from Bana Nature Reserve, Na Hang, Tatke Sector, Vietnam.

Calotes versicolor (Daudin, 1802)

Material examined. – MNHN 2003.3308-3309 (females; SVL 76 mm, TaL 219 mm; SVL 73 mm, Tal 203 mm), Huay Say [Say Stream], south of Kiatngong, Xepian NBCA, Champasak Province. - MNHN 2003.3311 (juvenile; SVL 38 mm, Tal 88 mm), southwest of Kiatngong, Xepian NBCA, Champasak Province. - MNHN 2003.3307, MNHN 2003.3318 (females; SVL 82 mm, TaL >137 mm; SVL 76 mm, TaL >101 mm), Sepian, Boloven Highlands, Champasak Province. - Several specimens (not preserved but photographed), Ventiane, Ventiane Prefecture.

Biology. – This species is common in forests and along forest edges, in gardens and along lanes of cities. Specimens MNHN 2003.3308-3309 were collected in forest on the bank of Say Stream, while MNHN 2003.3311 was obtained in a ricefield. Specimen MNHN 2003.3318 was collected at dusk in a gallery forest.

Draco maculatus (Gray, 1845)

Material. – MNHN 2003.3305-3306 (males; SVL 77 mm, TaL 112 mm; SVL 76 mm, TaL 121 mm), Xepian NBCA, Champasak Province.

Biology. – Several specimens were observed in primary and secondary forests.

* *Gonocephalus grandis* (Gray, 1845)

Material examined. – MNHN 2003.3368 (female; SVL 62 mm, TaL 148 mm), near Kiatngong, Xepian NBCA, Champasak Province.

Biology. – This specimen was found asleep on a branch at 2 m above the ground, in a rocky part of the evergreen forest bordering Kiatngong marsh.

Note. – The occurrence in southern Laos of this Indo-Malayan species represents a major extension of range of about 1050 airline kilometers across the Gulf of Siam. Its previously northernmost known localities were in the provinces of Satun and Songkhla, in extreme southern Thailand (Taylor, 1963). This species, widely distributed in Malaysia and Western Indonesia, is otherwise unknown from other parts of the Indochinese Peninsula.

Pseudocalotes poilani (Bourret, 1939)

Material examined. – MNHN 2003.3319 (female; SVL 78.8 mm, TaL 124 mm) and 1 specimen (photographed but not collected), Sepian, Boloven Highlands, Champasak Province.

Biology. – Both specimens were observed at night perched on branchs above a small stream.

Note. – We identified this specimen on the basis of Bourret (1939) and Hallermann and Böhme (2000). The type locality of this rare species was given by Bourret (1939) as "Bas Laos, entre Pak Song et Pak Sé" [Lower Laos, between Paksong and Pakse], namely at the northern edge of the Boloven Highlands. A casual scanning of the literature suggests that the present specimens are the second and third known for this species. Specimen MNHN 2003.3319 has 54 scale rows at midbody vs. 60 rows for the specimen described by Bourret (1939); other characters agree well.

This species was not mentioned by Stuart (1999), although he recorded *Pseudocalotes microlepis* (Boulenger, 1888) from the Annamite

FIGURE 1: *Kalophrynus interlineatus* (Blyth, 1855) in life, Xepian NBCA, Champasak Province (Photo A. Pourchon).

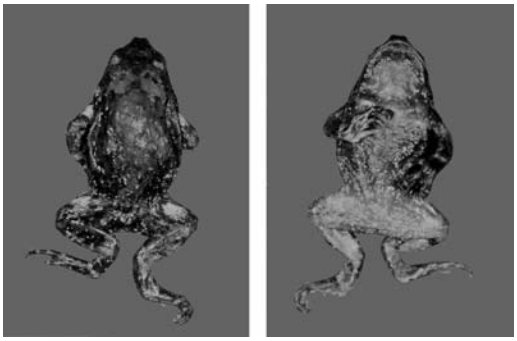

FIGURE 2: *Kaloula baleata* (Müller, 1836) MNHN 2003.1170, Kiatngong, Xepian NBCA, Champasak Province (Photo A. Ohler).

FIGURE 3: *Chirixalus nongkorensis* (Cochran, 1927) in life, Xepian NBCA, Champasak Province (Photo A. Pourchon).

FIGURE 4: *Pseudocalotes poilani*, in life, Sepian, Boloven Highlands (Photo A. Pourchon).

Range in southern Laos. This latter species is known from South Myanmar, South Thailand, southern Laos and from Langbian Plateau in South Vietnam. We could not compare Stuart's material with our own specimen.

Scincidae Gray, 1825

Eutropis longicaudata (Hallowell, 1857)

Material examined. – MNHN 2003.3317 (female; SVL 112 mm, TaL 184 mm), Xepian NBCA, Champasak Province.

Biology. – This specimen was collected at the edge between a forest and a marsh, while it was active at 11 AM on a ricestraw bundle.

Note. – We follow Mausfeld et al. (2002) and Mausfeld and Schmitz (2003) in referring to the genus *Eutropis* Fitzinger, 1843 Asian species formerly placed in the genus *Mabuya*.

Eutropis macularia (Blyth, 1853)

Material examined. – MNHN 2003.3316 (male; SVL 50 mm, TaL 66 mm [broken]), near Kiatngong, Xepian NBCA, Champasak Province. - MNHN 2003.3353 (male; SVL 67 mm, TaL 97 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – In Xepian NBCA, MNHN 2003.3316 and several other specimens were observed in primary and secondary forests. This species is more common in Boloven Highlands along forest edges and especially in disturbed areas.

Eutropis multifasciata (Kuhl, 1820)

Material examined. – Several specimens (not preserved), Xepian NBCA, Champasak Province. - Several specimens (not preserved), Sepian, Boloven Highlands, Champasak Province.

FIGURE 5: *Riopa corpulenta* (MNHN 2003.3322) in life, Sepian, Boloven Highlands, June 2003 (Photo A. Pourchon).

FIGURE 6: *Oreophis porphyraceus vaillanti* (MNHN 2003.3337) in life, Sepian, Boloven Highlands, June 2003 (Photo A. Pourchon).

FIGURE 7: *Trimeresurus macrops* (male) in life, Xepian NBCA, May 2003 (Photo A. Pourchon).

- Several specimens (not preserved), Pakse, vicinity of the stadium, Champasak Province.

Biology. – All specimens were observed during the day. This species is fairly common in Xepian NBCA, especially in disturbed areas, but is much more scarce in surveyed places of the Boloven Highlands, where it was also seen in disturbed habitats.

Lipinia vittigera (Boulenger, 1894)

Material. – 1 specimen (not preserved but photographed), Xepian NBCA, Champasak Province.

Biology. – This specimen was observed by day on the floor of an open forest.

Lygosoma quadrupes (Linnaeus, 1758)

Material examined. – MNHN 2003.3327 (sex unknown; SVL 45 mm, TaL 23 mm), Xepian NBCA, Champasak Province. - 1 specimen

FIGURE 8: *Trimeresurus vogeli* (juvenile male) in life, Sepian, Boloven Highlands, June 2003 (Photo A. Pourchon).

(not preserved), Sepian, Boloven Highlands, Champasak Province.

Biology. – In Xepian NBCA, this species has been found close to rice paddies bordered by forest. In the Boloven Highlands, it has been seen at the edge of forests and fields.

Note. – This wide ranging species was not mentioned by Stuart (1999), but it was cited from Laos by Welch et al. (1990).

* *Riopa angeli* Smith, 1938

Material examined. – MNHN 2003.3304 (male; SVL 100 mm, TaL 88 mm), Xepian NBCA, Champasak Province.

Biology. – Collected under the bark of a stump in a forest on the edge of a riparian area.

Note. – This species was previously known from its holotype and paratype, collected at Trang Bom, near Bien Hoa, Dong Nai Province, Vietnam (Smith, 1938), and from another specimen from Ma Da, in same province (Bobrov, 1992). We examined the holotype (MNHN 1937.0021), and it is identical in scalation and pattern to our specimen. Contrary to Smith's description, both the holotype and our specimen show a pair of slightly enlarged nuchals on each side.

* *Riopa bowringii* (Günther, 1864)

Material examined. – MNHN 2003.3320 (male; SVL 41 mm, TaL >12 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – A species common among volcanic boulders bordering a pond in an open forest.

Note. – This species was not mentioned by Stuart (1999).

Riopa corpulenta (Smith, 1921)

Material examined. – MNHN 2003.3322 (male; SVL 164 mm, TaL 140 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This large specimen and another adult were found inside a large fallen trunk at the edge of a coffee plantation.

Note. – This species seems to be very scarce. Smith (1935) mentioned only two specimens known at his time. We examined both of them (BMNH 1946.8.3.66, from "Dalat, South Annam" and MNHN 1897.0416, from "Ban Taxeng, Pays des Khas", now Ban Tasseng, Attapu Province, Laos), which are very similar in coloration and scalation. Our specimen has 34 scale rows at midbody, 6 supralabials, supranasals entire and in contact, and 2 frontoparietals behind the frontal. The discovery of this species in the Boloven Highlands extends the range of this species only slightly northwestwards, but would suggest that it is restricted to wet montane areas.

Scincella rufocaudata (Darevsky & Nguyen, 1983)

Material examined. – MNHN 2003.3314 (female; SVL 46, Tal > 49 mm), Sepian, Boloven Highlands, Champasak Province. - MNHN 2003.3315 (male; SVL 45 mm, Tal 87 mm), near a stream between Phu San [Mt. San] and Phu Say [Mt. Say], Xepian NBCA, Champasak Province.

Biology. – Specimen MNHN 2003.3314 was removed from beneath a wet stone in the stream, while MNHN 2003.3315 was collected on a rock in a dry area near human dwellings.

Note. – There is still considerable confusion in the taxonomy of Indochinese species of the

genus *Scincella*. Both specimens cited in this account agree very well with the description of *Sphenomorphus rufocaudatus* (Darevsky & Nguyen, 1983), a species placed in the genus *Scincella* by Bobrov (1993), and not considered by Ouboter (1986). We compared our specimens with three of the syntypes of *Lygosoma melanostictum* Boulenger, 1887, now *Scincella melanosticta*. Although these species are morphologically very close, our specimens agree better with the description of *Scincella rufocaudata*, a taxon cited from Central Laos by Stuart (1999), than with *Scincella melanosticta*. They are characterized by limbs barely in contact when adpressed, 32-34 dorsal scale rows and the presence of vivid pale red tail on lower surface of the male. It is possible that specimens cited by Stuart (1999) as *Scincella reevesii* (Gray, 1839) are indeed referrable to *Scincella melanosticta*. This latter species has not yet been cited from Laos.

* *Scincella rupicola* (Smith, 1916)

Material examined. – MNHN 2003.3310 (sex unknown; SVL 45 mm, TaL 61 mm), near Kiatngong, Xepian NBCA, Champasak Province.

Biology. – This specimen was active by day in a rocky clearing crossed by a stream.

Note. – The morphology of this specimen agrees well with the characters of *Lygosoma rupicola* Smith, 1916 as given in Taylor (1963) and Ouboter (1986). It has 32 dorsal scale rows and one pair of slightly enlarged nuchals. This poorly known taxon has previously been recorded from eastern Thailand and southern Vietnam.

Sphenomorphus maculatus (Blyth, 1853)

Material examined. – MNHN 2003.3302-3303 (males; SVL 37 mm, TaL 58 mm; SVL 41 mm, TaL > 72 mm), Xepian NBCA, Champasak Province.

Biology. – Both specimens were collected while they were foraging in the morning on rocky soil among bushes on the edge of a dry ricefield.

* *Sphenomorphus tridigitus* (Bourret, 1939)

Material examined. – MNHN 2003.3367 (sex unknown; SVL 35 mm, TaL 29 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This specimen was collected by day, hidden inside a log laying on grass near a small creek in an open forest.

Note. – This specimen is the second known of this very rare species, previously known only from the holotype (MNHN 1948.0060). Its description and generic allocation will be treated elsewhere (Greer et al., submitted.)

* *Tropidophorus microlepis* Günther, 1861

Material examined. – MNHN 2003.3321 (male; SVL 67 mm, TaL 79 mm), Huay Saoe [Saoe Stream], near Taong, Xepian NBCA, Champasak Province. - 1 specimen (not preserved), Huay Say [Say Stream], near Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Specimen MNHN 2003.3321 was removed from a stone in the water of the stream.

Note. – This specimen agrees well with the description appearing in Smith (1935). It is definitely not *Tropidophorus laotus* Smith, 1923, a species cited by Stuart (1999).

Lacertidae Batsch, 1788

Takydromus sexlineatus ocellatus Cuvier, 1829

Material examined. – MNHN 2003.3313 (female; SVL 44 mm, TaL >116 mm), southwest of Kiatngong, Xepian NBCA, Champasak Province.

Biology. – This specimen was collected in a ricefield. Another adult specimen, not collected, was observed once in an open area.

Note. – The authorship of the family Lacertidae follows Dubois (2004).

Varanidae Gray, 1827

Varanus salvator (Laurenti, 1768)

Material examined. – 5 specimens (not collected, offered for sale by native people), Xepian NBCA, Champasak Province. - 1 specimen seen in Pakse market, Champasak Province.

Note. – A species regarded as "Potentially at risk" in Laos by Stuart (1999).

SERPENTES

Typhlopidae Gray, 1825

Ramphotyphlops braminus (Daudin, 1803)

Material examined. – MNHN 2003.3349-3350 (TL 62 mm; TL 104 mm [SVL 101 mm, TaL 3 mm]), Xepian NBCA, Champasak Province.

Biology. – Specimens seen under stones and decayed wood in forest or at forest edge.

Xenopeltidae Bonaparte, 1845

Xenopeltis unicolor Boie, 1827

Material examined. – MNHN 2003.3335 (juvenile; SVL 202 mm, TaL 26 mm), Xepian NBCA, Champasak Province.

Biology. – This specimen, with a bright white-pink nuchal collar (turning to pure white in presevative), was collected at the limit between a marsh and a forest while it was active at night after a heavy rainshower.

Note. – This species was not listed from southern Laos by Stuart (1999), although Deuve (1970) cited it from this part of the country.

Cylindrophiidae Fitzinger, 1843

Cylindrophis ruffus (Laurenti, 1768)

Material examined. – MNHN 2003.3333 (SVL 205 mm, Tal 7 mm) and 2 specimens (adult; not preserved), Xepian NBCA, Champasak Province.

Biology. – One adult was found dead on the road, whereras the second one was discovered under a large stone at the edge of a marsh. The juvenile specimen was collected at night at the border of a marsh and a forest after a rainshower.

Note. – This species was not cited from southern Laos by Stuart (1999), although Deuve (1970: 69) suggested that it was often met with in the southern part of this country.

Pythonidae Fitzinger, 1826

Python molurus bivittatus Kuhl, 1820

Material examined. – 1 specimen (freshly prepared skin of a subadult specimen, TL slightly above 2 m), an isolated hamlet on the bank of a tributary of Kong River, on the road from Paksong to Attapu, Champasak Province.

Note. – This specimen was obviously recently killed in the vicinity of the village.

Colubridae Oppel, 1811

Ahaetulla prasina (Boie, 1827)

Material examined. – MNHN 2003.3352 (SVL 806 mm, TaL 474 mm), Xepian NBCA, Champasak Province.

Biology. – Collected by day, perched at about 1.5 m above the ground on a bush in a clearing of an evergreen forest.

Note. – This beautiful specimen was in life bright golden yellow speckled with black on the first half of the body (as depicted in Stuart, 1999: Plate 10), turning to mid-grey on the posterior half of the body and tail after a short area of transition.

Calamaria pavimentata Duméril, Bibron & Duméril, 1854

Material examined. – MNHN 2003.3340 (SVL 160 mm, TaL 12 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This adult specimen was collected under a stone in a small banana groove.

Note. – This species had not been previously reported from southern Laos. It was not cited from Laos by Stuart (1999), but was mentioned from North Laos by Inger and Marx (1965) and Deuve (1970).

Chrysopelea ornata (Shaw, 1802)

Material examined. – MNHN 2003.3365 (female; SVL 598 mm, TaL 249 mm) and 1 specimen (not collected), Th Na, Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Specimen MNHN 2003.3365 was collected by day perched at 1.5 m above the ground on a bush on the edge of a cultivated area. The other specimen was seen perched in same conditions in a plantation of teak.

Coelognathus radiatus (Boie, 1827)

Material examined. – MNHN 2003.3336 (female; SVL 321 mm, TaL 77 mm), Sepian, Boloven Highlands, Champasak Province. - 1 specimen (juvenile; photographed), Si Phan

Don [= Four Thousand Islands], Champasak Province.

Biology. – Specimen MNHN 2003.3336 was collected while it crossed a road by day near a coffee plantation. The second animal was observed swimming between two islands of the Mekong at more than 100 m from the shore.

Note. – We follow Helfenberger (2001) and Utiger et al. (2002), who placed this species into the genus *Coelognathus* Fitzinger, 1843.

Dendrelaphis cyanochloris (Wall, 1921)

Material examined. – MNHN 2003.3328 (female; SVL 889 mm, TaL 431 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This snake was collected by day foraging on the ground in a coffee plantation.

Note. – Our specimen, with a total length of 1320 mm is close to the maximal total length (1330 mm) reported by Manthey and Grossmann (1997). This species has not been previously reported from southern Laos. Stuart (1999) recorded it from Annamite foothills of central Laos.

Dendrelaphis pictus (Gmelin, 1789)

Material examined. – MNHN 2003.3354-3356 (males; SVL 573 mm, TaL 297 mm; SVL 546 mm, TaL 271 mm; SVL 394 mm, TaL 179 mm), Xepian NBCA, Champasak Province. - MNHN 2003.3357 (female; SVL 719 mm, TaL 318 mm), Kiatngong, Xepian NBCA, Champasak Province.

Biology. – A common species, active by day or often at night, between 2 and 4 m above the ground on bushes and bamboo clumps at the edge of marshes. Specimen MNHN 2003.3357 was crossing a ricefield.

Enhydris jagorii (Peters, 1863)

Material examined. – MNHN 2003.3347-3348 (females; SVL 353 mm, TaL 70 mm; SVL 155 mm, TaL 33 mm), Xepian NBCA, Champasak Province.

Biology. – This species is common in the vicinity of marshes and rice paddies. It is active at night, more rarely during day time.

Enhydris plumbea (Boie, 1827)

Material examined. – MNHN 2003.3341 (male; SVL 295 mm, TaL 37 mm), MNHN 2003.3342 (female; SVL 135 mm, TaL 20 mm), Xepian NBCA, Champasak Province. - MNHN 2003.3346 (male; SVL 241 mm, TaL 38 mm), Kiatngong, Xepian NBCA, Champasak Province.

Biology. – A species commonly seen in the vicinity of marshes and paddies. Specimen MNHN 2003.3346 was collected under a stone near a pond.

* *Oligodon barroni* (Smith, 1916)

Material examined. – MNHN 2003.3329 (male; see Table 1), Xepian NBCA, Champasak Province. - MNHN 2003.3330 (female; see Table 1), Huay Saoe [Saoe Stream], near Taong, Champasak Province.

Biology. – The specimen from Xepian NBCA was collected during day time at the edge of a forest. The other snake was removed from beneath a stone laying on wet sand on the bank of Saoe Stream.

Note. – This species was not mentioned by Stuart (1999), and Deuve (1970) listed it only as a potential Laotian species. It is otherwise known from Thailand, Cambodia and South Vietnam.

Oligodon cinereus (Günther, 1864)

Material examined. – MNHN 2003.3332 (female; see Table 1), Xepian NBCA, Champasak Province.

Biology. – This specimen was collected during day time at the edge of a forest.

Note. – This juvenile was brightly coloured in life, with a reddish-brown background with white, black-edged crossbars. It belongs to Form IV of Smith (1943: 217), known from central and southern Vietnam. This species was not cited from southern Laos by Stuart (1999).

* *Oligodon fasciolatus* (Günther, 1864)

Material examined. – MNHN 2003.3344 (female; see Table 1), Vientiane, Vientiane Prefecture.

Biology. – This juvenile specimen was collected at night in the room of a hotel in the city of Vientiane.

Note. – We follow Wagner (1975) in referring Indochinese populations with 21 or 23 scale rows at midbody, long identified in the literature as *Oligodon cyclurus*, to *Oligodon fasciolatus* (Günther, 1864). As a result, *Oligodon fasciolatus* is known from eastern Myanmar, Thailand, Cambodia, Laos and Vietnam, whereas *O. cyclurus* (Cantor, 1839) is restricted to India, Bangladesh, and western, central and northern Myanmar. More information on this synonymy appeared in Pauwels et al. (2002). This species was cited, from North Laos only, by Stuart (1999: 59; Pl. 10) as *Oligodon cyclurus*. Deuve (1970: 153) mentioned it as *Holarchus purpurascens* (Schlegel, 1837).

* *Oligodon inornatus* (Boulenger, 1914)

Material examined. – MNHN 2003.3331 (female; see Table 1), Xepian NBCA, Champasak Province.

Biology. – This specimen was collected by day while crossing a forest path.

Note. – We follow Wagner (1975) for the definition of this species. It was not mentioned by Stuart (1999). It is otherwise known from estern Thailand and Cambodia.

* *Oligodon ocellatus* (Morice, 1875)

Material examined. – MNHN 2003.3343 (female; see Table 1), Xepian NBCA, Champasak Province.

Biology. – The sole observed specimen was seen during day time at the edge of a primary forest.

Note. – We follow Wagner (1975) for the definition of this species, long confused with *Oligodon cyclurus*. In pattern and scalation, our specimen is typical of *Oligodon ocellatus*. This species has not previously been cited under this name from Laos. It is otherwise known from Cambodia and Vietnam.

Oreophis porphyraceus vaillanti (Sauvage, 1876)

Material examined. – MNHN 2003.3337 (female; SVL 502 mm, TaL 105 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This adult was collected while active at night at the limit between a cultivated area and a forest.

Note. – We follow Utiger et al. (2002), who placed this species, long known as *Elaphe porphyracea*, into their new genus *Oreophis*. Although *Oreophis porphyraceus* has previously been cited from North Laos by Deuve (1970), Schulz (1996), Schulz and Helfenberger (1998) and Stuart (1999), its occurrence in the Boloven Highlands represents a southeastwards range extension of about 550 airline kilometers from the previously southernmost known locality. Following Schulz and Helfenberger (1998) and on the basis of its scalation and pattern, the present specimen is referrable to *Oreophis porphyraceus vaillanti* (Sauvage, 1876), a taxon otherwise known from southeastern China, northern Vietnam and northern Laos.

Pareas hamptoni (Boulenger, 1905)

Material examined. – MNHN 2003.3338 (male; SVL 331 mm, TaL 105 mm), 1 specimen (adult, not preserved but photographed), Sepian, Boloven Highlands, Champasak Province.

Biology. – Both specimens were seen at night near a forest stream. One was coiled on a fern overhanging water, the other one was active in foliage at about 2.5 m above the ground.

Note. – This species has been recorded from Laos, but was not cited from the South by Stuart (1999).

Pareas margaritophorus (Jan, 1866)

Material examined. – MNHN 2003.3339 (female; SVL 351 mm, TaL 63 mm), Sepian, Boloven Highlands, Champasak Province.

Biology. – This snake was discovered inside a burned trunk along with six eggs.

Psammodynastes pulverulentus (Boie, 1827)

Material examined. – MNHN 2003.3334, MNHN 2003.3370 (females; SVL 282 mm, TaL 67 mm; SVL 385 mm, Tal 87 mm), Xepian NBCA, Champasak Province.

Biology. – Specimen MNHN 2003.3334 was collected on a forest path during day time. The other one was obtained by day while it was perched at about 1.5 m on a branch over a dry stream in an open forest.

Note. – This species has been recorded from Laos, but was not cited from the South by Deuve (1970) and Stuart (1999).

Ptyas korros (Schlegel, 1837)

Material examined. – 1 specimen (not preserved), Xepian NBCA, Champasak Province.

Note. – Several specimens were seen offered for sale on Pakse market, Champasak Province. This species was regarded as "Potentially at risk" in Laos by Stuart (1999).

Ptyas mucosa (Linnaeus, 1758)

Material examined. – Several specimens (not preserved), offered for sale in Pakse market, Champasak Province.

Note. – A species regarded as "Potentially at risk" in Laos by Stuart (1999).

Rhabdophis subminiatus subminiatus (Schlegel, 1837)

Material examined. – MNHN 2003.3351 (head and anterior part of body only), 1 specimen (not preserved), Sepian, Boloven Highlands, Champasak Province. - MNHN 2003.3366 (female; SVL 513 mm, TaL 183 mm), Kiatngong, Xepian NBCA, Champasak Province.

Biology. – Specimens from the Boloven Highlands were found dead on the road near the village of Ban Sepian. Specimen MNHN 2003.3366 was collected by day near a small river bordering grassland and cultivated areas.

Xenochrophis flavipunctatus (Hallowell, 1860)

Material examined. – MNHN 2003.3345 (female; SVL 441 mm, TaL 173 mm), Kiatngong, Xepian NBCA, Champasak Province. - 1 specimen (kept alive), Xepian NBCA, Champasak Province.

Biology. – MNHN 2003.3345 was collected in a ricefield between the village and a marshland. The other specimen, an adult female, was collected during day time by a native.

Note. – Contrary to Deuve (1970) and Stuart (1999), we regard *Xenochrophis flavipunctatus* and *Xenochrophis piscator* (Schneider, 1799) as distinct species. These taxa are identifiable with the key provided by Taylor (1965: 832).

Crotalidae Oppel, 1811

* *Trimeresurus macrops* Kramer, 1977

Material examined. – MNHN 2003.3358-3360 (male; juvenile female; juvenile male; see Table 2), Xepian NBCA, Champasak Province.

Biology. – A locally common species in evergreen forest. We observed five adult or subadult males and three juvenile specimens, all in the vegetation of forest rocky outcrops, both during day and night.

Note. – This species was previously known from Thailand (Centre, North and East), Cambodia and Vietnam (David and Ineich, 1999). Main morphological characters of our specimens are given in Table 2. It should be noted that specimen MNHN 2003.3360 has 19 dorsal scale rows at midbody, a rare condition in this species. Specimen MNHN 2003.3358 is depicted alive on Fig. 7. We examined another Laotian specimen of this species (FMNH 254800; from Lac Xao, Bolikhamxay Province), in Centre Laos, which was previously identified as *Trimeresurus popeiorum* Smith, 1937 (possibly one of the two specimens of this latter species cited by Stuart [1999] from central Laos). *Trimeresurus macrops* has long been confused with *Trimeresurus albolabris* (Gray, 1842), a species of open vegetation, which was not encountered during the present survey.

Trimeresurus vogeli David, Vidal & Pauwels, 2001

Material examined. – MNHN 2003.3361-3364 (2 males, 2 females; see Table 2) and 1 specimen (juvenile, alive at the time of writing this paper), Sepian, Boloven Highlands, Champasak Province.

Biology. – One specimen was collected during day time in a coffee plantation, one at a

TABLE 1: Primary morphological characters of specimens of *Oligodon*.

Number	Sex	SVL	TaL	TaL/ TL	VEN	SC	MSR	PSR	SL	IL	Tem
Oligodon barroni											
MNHN 2003.3329	M	262	62	0.191	143	42	17	15	7/7	9/9	1+2/1+2
MNHN 2003.3330	F	312	51	0.140	152	34	17	15	7/7	9/9	1+2/1+2
Oligodon cinereus											
MNHN 2003.3332	F	144	17	0.106	167	31	15	15	8/8	8/8	1+2/1+2
Oligodon fasciolatus											
MNHN 2003.3344	F	148	22	0.129	181	40	21	17	8/8	9/9	1+2/1+2
Oligodon inornatus											
MNHN 2003.3331	F	144	17	0.106	161	31	15	15	8/7	7/7	1+2/1+2
Oligodon ocellatus											
MNHN 2003.3343	F	339	56	0.142	165	41	19	15	8/9	10/10	2+2/2+2

TABLE 2: Primary morphological characters of specimens of *Trimeresurus*.

Number	Sex	SVL	TaL	TaL/TL	VEN	SC	MSR	SL	C3Sl	C4SL	Cep
Trimeresurus macrops											
MNHN 2003.3358	M	322	81	0.201	164	72	21	10/9	0/0	1/1	7
MNHN 2003.3359	F	176	31	0.150	167	54	21	10/11	1/0	1/1	9
MNHN 2003.3360	M	168	40	0.192	164	70	19	10/10	0/0	0/0	8
Trimeresurus vogeli											
MNHN 2003.3361	F	670	141	0.174	158	61	20	10/10	0/1	1/1	11
MNHN 2003.3362	M	508	117	0.187	160	68	21	10/9	0/0	1/1	14
MNHN 2003.3363	F	633	124	0.163	157	61	21	10/10	0/0	1/1	13
MNHN 2003.3364	M	400	90	0.184	160	71	21	9/9	0/0	1/1	12

TABLE 3: List of reptiles and amphibians recorded from Xepian NBCA, Sepian, and other localities of southern Laos. *Abbreviations*. XEP: Xepian NBCA; SEP: Sepian, Boloven Highlands; SLa: Other localities in southern Laos. For these three columns, data come from this paper and cited references.

Taxa	XEP	SEP	SLa	References
AMPHIBIA				
GYMNOPHIONA				
Ichthyophidae				
Ichthyophis cf. *kohtaoensis* (Taylor, 1960 [1])	X	X	X	Stuart (1999); this paper
ANURA				
Bufonidae				
Bufo galeatus Günther, 1864	-	-	X	Stuart (1999)
Bufo macrotis Boulenger, 1887	-	-	X	Stuart (1998, 1999)
Bufo melanostictus (Schneider, 1799)	X	X	X	Stuart (1998, 1999); this paper
Megophryidae				
Leptobrachium banae Lathrop, Murphy, Orlov & Ho, 1998	-	-	X	Stuart (1999)
Leptobrachium sp.	-	X	-	This paper
Leptolalax pelodytoides (Boulenger, 1893)	-	-	X	Stuart (1999)
Microhylidae				
Calluella guttulata (Blyth, 1855)	-	-	X	Stuart (1999)
Glyphoglossus molossus Günther, 1859	-	-	X	Stuart (1999); this paper
Kalophrynus interlineatus (Blyth, 1855)	X	-	X	Stuart (1999 [2]); this paper
Kaloula baleata (Müller, 1836)	X	-	-	This paper

Taxa	XEP	SEP	SLa	References
Kaloula pulchra Gray, 1831	-	-	X	Stuart (1998, 1999); this paper
Kaloula mediolineata Smith, 1917	-	-	X	Stuart (1999)
Microhyla annamensis Smith, 1923	-	-	X	Stuart (1999)
Microhyla berdmorei (Blyth, 1856)	X	-	X	Stuart (1998, 1999); this paper
Microhyla butleri Boulenger, 1900	X	-	X	Stuart (1998, 1999); this paper
Microhyla heymonsi Vogt, 1911	-	-	X	Stuart (1998, 1999)
Microhyla ornata (Duméril & Bibron, 1841)	-	-	X	Stuart (1998, 1999)
Microhyla pulchra (Hallowell, 1861)	-	-	X	Stuart (1998, 1999)
Micryletta inornata (Boulenger, 1890)	-	-	X	Stuart (1999)
Ranidae				
Chirixalus doriae Boulenger, 1893	-	X	X	Stuart (1999); this paper
Chirixalus nongkhorensis (Cochran, 1927)	X	-	X	Stuart (1998, 1999); this paper
Fejervarya limnocharis (Gravenhorst, 1829)	X	X	X	Stuart (1998, 1999); this paper
Hoplobatrachus chinensis (Osborn, 1765)	-	-	X	Stuart (1998, 1999 [3])
Limnonectes sp.	X	X	X	Stuart (1999 [4]); this paper
Paa microlineata (Bourret, 1937)	-	-	X	Stuart (1999)
Polypedates leucomystax group	X	X	X	Stuart (1998, 1999); this paper
Philautus gryllus Smith, 1924	-	X	-	This paper
Philautus odontotarsus Ye & Fei, 1993	-	X	-	This paper
Occidozyga lima (Gravenhorst, 1829)	-	-	X	Stuart (1998, 1999 [5])
Phrynoglossus martensii Peters, 1867	X	-	X	Stuart (1998, 1999); this paper
Rana attigua Inger Orlov & Darevsky, 1999	-	-	X	Stuart (1999)
Rana erythraea (Schlegel, 1837)	X	-	X	Stuart (1998, 1999); this paper
Rana johnsi Smith, 1921	-	-	X	Stuart (1999)
Rana lateralis Boulenger, 1887	-	-	X	Stuart (1998, 1999)
Rana macrodactyla (Günther, 1859)	X	-	X	Stuart (1998, 1999); this paper
Rana morafkai Bain, Lathrop, Murphy, Orlov & Cuc, 2003	-	X	X	Stuart (1999 [6]); this paper
Rana nigrovittata (Blyth, 1855)	X	-	X	Stuart (1998, 1999) ; this paper
Rana taipehensis Van Denburgh, 1909	X	-	X	Stuart (1998, 1999) ; this paper
Rhacophorus baliogaster Inger, Orlov & Darevsky, 1999	-	-	X	Stuart (1999 [7])
Rhacophorus exechopygus Inger, Orlov & Darevsky, 1999	-	-	X	Stuart (1999)
Total Amphibia	15	10	37	

REPTILIA				
Chelonii				
Platysternidae				
Platysternon megacephalum Gray, 1831	-	-	X	Stuart (1999)
Trionychidae				
Amyda cartilaginea (Boddaert, 1770)	-	-	X	Stuart (1998, 1999); this paper
Pelochelys cantorii Gray, 1864	-	-	X	Stuart (1998 [8], 1999)
Bataguridae				
Cuora amboinensis (Daudin, 1801)	X	-	X	Stuart (1998, 1999)
Cyclemys dentata (Gray, 1831)	-	-	X	Stuart (1999)
Heosemys grandis (Gray, 1860)	X	-	X	Stuart (1998, 1999)
Hieremys annandalii (Boulenger, 1903)	X	-	X	Stuart (1998, 1999)
Malayemys subtrijuga (Schlegel & Müller, 1844)	X	-	-	Stuart (1998, 1999)

Taxa	XEP	SEP	SLa	References
Testudinidae				
Indotestudo elongata (Blyth, 1853)	X	-	X	Davidson et al. (1997); Stuart (1998, 1999)
Manouria impressa (Günther, 1882)	-	-	X	Stuart (1999)
CROCODYLIA				
Crocodylidae				
Crocodylus siamensis Schneider, 1801	-	-	X ?	Stuart (1999); probably extinct
Lacertilia				
Gekkonidae				
Cosymbotus platyurus (Schneider, 1799)	-	-	X	Stuart (1999); this paper
Cyrtodactylus sp.	X	-	-	This paper
Dixonius siamensis (Boulenger, 1898)	X		X	Stuart (1998, 1999 [9]) ; this paper
Gekko gecko (Linnaeus, 1758)	X	-	X	Stuart (1998, 1999); this paper
Gekko petricolus Taylor, 1962	-	-	X	Stuart (1999)
Hemidactylus frenatus Duméril & Bibron, 1836	-	-	X	Stuart (1999) ; this paper
Hemidactylus garnotii Duméril & Bibron, 1836	-	-	X	Stuart (1999)
Agamidae				
Acanthosaura capra Günther, 1861	-	-	X	Stuart (1999)
Acanthosaura lepidogaster (Cuvier, 1829)	X	-	X	Stuart (1999); this paper
Calotes emma Gray, 1845	-	-	X	Stuart (1999)
Calotes versicolor (Daudin, 1802)	X	X	X	Stuart (1998, 1999); this paper
Draco maculatus (Gray, 1845)	X	-	X	Stuart (1999); this paper
Gonocephalus grandis (Gray, 1845)	X	-	-	This paper
Physignathus cocincinus Cuvier, 1829	X	-	X	Stuart (1998, 1999)
Pseudocalotes microlepis (Boulenger, 1888)	-	-	X	Stuart (1999)
Pseudocalotes poilani (Bourret, 1939)	-	X	-	This paper
Uromastycidae				
Leiolepis belliana (Gray, 1827)	-	-	X	Stuart (1999)
Leiolepis rubritaeniata Mertens, 1961	-	-	X	Stuart (1998 [10], 1999)
Scincidae				
Eutropis longicaudata (Hallowell, 1857)	X	-	X	Stuart (1998, 1999); this paper
Eutropis macularia (Blyth, 1853)	X	X	X	Stuart (1998, 1999); this paper
Eutropis multifasciata (Kuhl, 1820)	X	X	X	Stuart (1998, 1999); this paper
Lipinia vittigera (Boulenger, 1894)	X	-	X	Stuart (1999); this paper
Lygosoma quadrupes (Linnaeus, 1758)	X	X	-	This paper
Riopa angeli Smith, 1938	X	-	-	This paper
Riopa bowringii (Günther, 1864)	-	X	-	This paper
Riopa corpulenta (Smith, 1921)	-	X	X	Smith (1935); This paper
Scincella rufocaudata (Darevsky & Nguyen, 1983)	X	X	-	This paper
Scincella rupicola (Smith, 1916)	X	-	-	This paper
Sphenomorphus indicus (Gray, 1853)	-	-	X	Stuart (1999)
Sphenomorphus maculatus (Blyth, 1853)	X	-	X	Stuart (1999); this paper
Sphenomorphus tridigitus (Bourret, 1939)	-	X	-	This paper
Tropidophorus microlepis Günther, 1861	X	-	-	This paper
Lacertidae				
Takydromus sexlineatus ocellatus (Cuvier, 1829)	X	-	-	This paper
Varanidae				
Varanus bengalensis nebulosus (Gray, 1831)	-	-	X	Davidson et al. (1997); Stuart (1998, 1999)

Taxa	XEP	SEP	SLa	References
Varanus salvator (Laurenti, 1768)	X	-	X	Davidson et al. (1997); this paper
SERPENTES				
Typhlopidae				
Ramphotyphlops braminus (Daudin, 1803)	X	-	X	Stuart (1998, 1999); this paper
Uropeltidae				
Cylindrophis ruffus (Laurenti, 1768)	X	-	-	This paper
Xenopeltidae				
Xenopeltis unicolor Boie, 1827	X	-	X	Deuve (1970); this paper
Pythonidae				
Python reticulatus (Schneider, 1801)	-	-	X	Davidson et al. (1997); Stuart (1998, 1999)
Python molurus bivittatus Kuhl, 1820	-	-	X	Stuart (1998, 1999); this paper
Colubridae				
Ahaetulla nasuta (Lacepède, 1789)	-	-	X	Stuart (1998, 1999)
Ahaetulla prasina (Boie, 1827)	X	-	X	Stuart (1999); this paper
Boiga cyanea (Duméril, Bibron & Duméril, 1854)	-	-	X	Stuart (1998, 1999)
Boiga ocellata Kroon, 1973	-	-	X	Stuart (1998 [11], 1999)
Boiga multomaculata (Boie, 1827)	-	-	X	Stuart (1999)
Calamaria pavimentata Duméril, Bibron & Duméril, 1854	-	X	-	This paper
Chrysopelea ornata (Shaw, 1802)	X	-	X	Stuart (1998, 1999); this paper
Coelognathus radiatus (Boie, 1827)	-	X	X	Stuart (1999); this paper
Dendrelaphis cyanochloris (Wall, 1921)	-	X	-	This paper
Dendrelaphis pictus (Gmelin, 1789)	X	-	X	Stuart (1998, 1999); this paper
Enhydris jagorii (Peters, 1863)	X	-	X	Stuart (1998, 1999); this paper
Enhydris plumbea (Boie, 1827)	X	-	-	Stuart (1998, 1999); this paper
Gonyosoma prasinum (Blyth, 1854)	-	-	X	Stuart (1999)
Homalopsis buccata (Linnaeus, 1758)	-	-	X	Stuart (1999)
Oligodon barroni (Smith, 1916)	X	-	-	This paper
Oligodon cinereus (Günther, 1864)	X	-	-	This paper
Oligodon inornatus (Boulenger, 1914)	X	-	-	This paper
Oligodon ocellatus (Morice, 1875)	X	-	-	This paper
Oreophis porphyraceus vaillanti (Sauvage, 1876)	-	X	-	This paper
Pareas hamptoni (Boulenger, 1905)	-	X	-	This paper
Pareas margaritophorus (Jan, 1866)	-	X	X	Stuart (1999); this paper
Psammodynastes pulverulentus (Boie, 1827)	X	-	-	This paper
Psammophis indochinenis Smith, 1943	-	-	X	Stuart (1998, 1999 [12])
Pseudoxenodon macrops (Blyth, 1854)	-	-	X	Stuart (1999)
Ptyas korros (Schlegel, 1837)	X	-	X	Stuart (1998, 1999); this paper
Ptyas mucosa (Linnaeus, 1758)	-	-	X	Stuart (1998, 1999) ; this paper
Rhabdophis chrysargos (Schlegel, 1837)	-	-	X	Stuart (1999)
Rhabdophis subminiatus (Schlegel, 1837)	X	X	X	Stuart (1998, 1999); this paper
Sibynophis collaris (Gray, 1853)	-	-	X	Stuart (1999)
Xenochrophis flavipunctatus (Hallowell, 1860)	X	-	X	Stuart (1998, 1999 [13]); this paper
Elapidae				
Bungarus candidus (Linnaeus, 1758)	-	-	X	Stuart (1998, 1999)
Naja siamensis Laurenti, 1768	-	-	X	Stuart (1999)
Ophiophagus hannah (Cantor, 1836)	-	-	X	Davidson et al. (1997); Stuart (1998, 1999)

Taxa	XEP	SEP	SLa	References
Crotalidae				
Calloselasma rhodostoma (Boie, 1827)	-	-	X	Gloyd & Conant (1990)
Ovophis monticola (Günther, 1864)	-	-	X	Stuart (1999)
Trimeresurus albolabris (Gray, 1842)	-	-	X	Stuart (1998 [14], 1999)
Trimeresurus macrops Kramer, 1977	X	-	-	This paper
Trimeresurus vogeli David, Vidal & Pauwels, 2001	-	X	-	Malhotra & Thorpe (2004); this paper
Total Reptilia	41	17	64	

Notes. [1] all Indochinese specimens of *Ichthyophis* with a yellow lateral band are currently considered to belong to this species; [2] as *Kalophrynus pleurostigma*; [3] as *Hoplobatrachus rugulosus*; [4] as *Limnonectes kuhlii* group; [5] as *Phrynoglossus lima*; [6] as *Rana livida* (Blyth, 1856); [7] should be the same taxon as *Philautus odontotarsus*; [8] as *Pelochelys bibroni*; [9] as *Phyllodactylus siamensis*; [10] as *Leiolepis belliana*; [11] as *Boiga cynodon*; [12] as *Psammophis condanarus*. *Psammophis indochinensis*, formerly considered a subspecies of *P. condanarus*, was raised to full species status by Hughes (1999); [13]: as *Xenochrophis piscator*; [14]: as *Trimeresurus stejnegeri*.

TABLE 4: Comparison between the amphibian and reptile fauna of southern Laos and adjacent areas. *Abbreviations*. - LaS: Southern Laos (as defined above); LaC: Central Laos (Provinces of Bolikhamxai, Khammouan and Savannakhet); LaN: Northern Laos (All provinces north of Bolikhamxai Province, including Vientiane Prefecture); ViS: South Vietnam (Provinces of Gia Lai and Binh Dinh, and all provinces further south); ViC: Central Vietnam (Ha Tinh Province and provinces between Ha Tinh and "ViS"); ViN: North Vietnam and China (Nghe An Province and all provinces further north, China); Cam: Cambodia; TaN: North and West Thailand (Provinces of Kanchanaburi and Tak, Provinces of Sukhothai, Phitsanulok and Loei and all provinces further north); TaC: Central and Eastern Thailand (All provinces east of Provinces of Ratchaburi, Kanchanaburi and Tak, and south of TaN); TaS: South Thailand (Ratchaburi Province and all provinces further south), West Malaysia.
Sources. - Smith (1931, 1935, 1943), Bourret (1936b, 1939, 1942), Taylor (1962, 1963, 1965), Saint-Girons (1972), Bobrov (1992, 1993), Iverson (1992), Wagner (1975), Cox (1991), Nguyen & Ho (1996), Szyndlar & Nguyen (1996), Wüster et al. (1997), Inger et al. (1999), Chan-ard et al. (2000), Daltry & Dany (2000), Ohler et al. (2002), Chan-ard (2003), Bain et al. (2003), Orlov et al. (2003).

Taxa	LaS	LaC	LaN	ViS	ViC	ViN	Cam	TaN	TaC	TaS
AMPHIBIA										
Gymnophiona										
Ichthyophidae										
Ichthyophis cf. *kohtaoensis* (Taylor, 1960)	X	X	-	X	X	X	X	X	X	X
Anura										
Bufonidae										
Bufo galeatus Günther, 1864	X	X	-	X	-	-	X	-	-	-
Bufo macrotis Boulenger, 1887	X	-	-	X	-	-	X	X	X	X
Bufo melanostictus (Schneider, 1799)	X	X	X	X	X	X	X	X	X	X
Megophryidae										
Leptobrachium banae Lathrop, Murphy, Orlov & Ho, 1998	X	-	-	-	X	-	-	-	-	-
Leptobrachium sp.	X	-	-	-	-	-	-	-	-	-
Leptolalax pelodytoides (Boulenger, 1893)	X	X	X	-	-	X	-	X	-	-
Microhylidae										
Calluella guttulata (Blyth, 1855)	X	-	X	X	-	-	-	X	X	X
Glyphoglossus molossus Günther, 1859	X	-	-	X	-	-	X	X	X	-
Kalophrynus interlineatus (Blyth, 1855)	X	X	-	-	-	X	X	X	X	-
Kaloula baleata (Müller, 1836)	X	-	-	-	-	-	-	-	-	X
Kaloula pulchra Gray, 1831	X	X	X	X	X	X	X	X	X	X
Kaloula mediolineata Smith, 1917	X	-	-	-	-	-	-	-	X	-
Microhyla annamensis Smith, 1923	X	X	-	X	-	-	X	-	X	-

Taxa	LaS	LaC	LaN	ViS	ViC	ViN	Cam	TaN	TaC	TaS
Microhyla berdmorei (Blyth, 1856)	X	X	X	X	X	-	X	X	X	X
Microhyla butleri Boulenger, 1900	X	X	X	X	X	X	X	X	X	X
Microhyla heymonsi Vogt, 1911	X	X	X	X	X	X	X	X	X	X
Microhyla ornata (Duméril & Bibron, 1841)	X	X	X	X	X	X	X	X	X	X
Microhyla pulchra (Hallowell, 1861)	X	X	X	X	X	X	X	X	X	-
Micryletta inornata (Boulenger, 1890)	X	X	X	X	X	X	X	X	X	X
Ranidae										
Chirixalus doriae Boulenger, 1893	X	-	X	X	-	X	X	X	-	-
Chirixalus nongkhorensis (Cochran, 1927)	X	-	-	X	-	-	X	X	X	-
Fejervarya limnocharis (Gravenhorst, 1829)	X	X	X	X	X	X	X	X	X	X
Hoplobatrachus chinensis (Osborn, 1765)	X	X	X	X	X	X	X	X	X	X
Paa microlineata (Bourret, 1937)	X	-	-	-	-	X	-	-	-	-
Polypedates leucomystax group	X	X	X	X	X	X	X	X	X	X
Philautus gryllus Smith, 1924	X	-	-	-	X	X	-	-	-	-
Philautus odontotarsus Ye & Fei, 1993	X	-	-	-	-	X	-	-	-	-
Occidozyga lima (Gravenhorst, 1829)	X	X	X	X	X	X	X	X	X	X
Phrynoglossus martensii Peters, 1867	X	X	X	X	X	X	X	X	X	X
Rana attigua Inger Orlov & Darevsky, 1999	X	-	-	-	-	-	-	-	-	-
Rana erythraea (Schlegel, 1837)	X	X	X	X	X	-	X	X	X	X
Rana johnsi Smith, 1921	X	X	X	X	-	X	-	X	-	-
Rana lateralis Boulenger, 1887	X	X	X	-	-	X	X	X	-	-
Rana macrodactyla (Günther, 1859)	X	X	X	X	X	X	X	X	X	X
Rana morafkai Bain, Lathrop, Murphy, Orlov & Cuc, 2003	X	-	-	X	-	-	-	-	-	-
Rana nigrovittata (Blyth, 1855)	X	X	X	X	X	X	X	X	X	X
Rana taipehensis Van Denburgh, 1909	X	X	-	X	X	X	X	-	X	-
Rhacophorus baliogaster Inger, Orlov & Darevsky, 1999	X	-	-	X	-	-	-	-	-	-
Rhacophorus exechopygus Inger, Orlov & Darevsky, 1999	X	-	-	X	-	-	-	-	-	-
Total Amphibia	40	24	21	29	20	24	26	26	25	19
% / Southern Laos	-	60.0	52.5	72.5	50.0	60.0	65.0	65.0	62.5	47.5
REPTILIA										
Chelonii										
Platysternidae										
Platysternon megacephalum Gray, 1831	X	X	X	X	X	X	-	X	X	X
Trionychidae										
Amyda cartilaginea (Boddaert, 1770)	X	X	X	X	X	-	X	X	X	X
Pelochelys cantorii Gray, 1864	X	-	-	-	X	X	X	X	X	X
Bataguridae										
Cuora amboinensis (Daudin, 1801)	X	-	-	X	X	-	X	X	X	X
Cyclemys dentata (Gray, 1831)	X	X	X	X	X	X	X	X	X	X
Heosemys grandis (Gray, 1860)	X	X	-	X	-	-	-	-	X	X
Hieremys annandalii (Boulenger, 1903)	X	-	-	X	-	-	X	-	X	X
Malayemys subtrijuga (Schlegel & Müller, 1844)	X	X	X	X	-	-	-	X	X	X
Testudinidae										
Indotestudo elongata (Blyth, 1853)	X	X	X	X	X	X	X	X	X	X
Manouria impressa (Günther, 1882)	X	X	X	-	X	X	X	X	X	X

Taxa	LaS	LaC	LaN	ViS	ViC	ViN	Cam	TaN	TaC	TaS
Crocodylia										
Crocodylidae										
Crocodylus siamensis Schneider, 1801	X	X	X	X *	X *	-	X	-	-	X
Lacertilia										
Gekkonidae										
Cosymbotus platyurus (Schneider, 1799)	X	X	X	X	-	X	X	X	X	X
Cyrtodactylus sp.	X	-	-	-	-	-	-	-	-	-
Dixonius siamensis (Boulenger, 1898)	X	-	X	X	-	-	X	X	X	X
Gekko gecko (Linnaeus, 1758)	X	X	X	X	X	X	X	X	X	X
Gekko petricolus Taylor, 1962	X	-	-	-	-	-	-	-	X	-
Hemidactylus frenatus Duméril & Bibron, 1836	X	X	X	X	X	X	X	X	X	X
Hemidactylus garnotii Duméril & Bibron, 1836	X	X	X	X	-	-	-	X	-	X
Agamidae										
Acanthosaura capra Günther, 1861	X	-	-	X	X	-	X	-	-	-
Acanthosaura lepidogaster (Cuvier, 1829)	X	X	X	X	X	X	X	X	X	-
Calotes emma Gray, 1845	X	X	X	X	X	X	X	X	-	X
Calotes versicolor (Daudin, 1802)	X	X	X	X	X	X	X	X	X	X
Draco maculatus (Gray, 1845)	X	X	X	X	X	X	X	X	X	X
Gonocephalus grandis (Gray, 1845)	X	-	-	-	-	-	-	-	-	X
Physignathus cocincinus Cuvier, 1829	X	X	-	X	X	X	X	-	X	-
Pseudocalotes microlepis (Boulenger, 1888)	X	-	X	X	-	X	-	-	-	-
Pseudocalotes poilani (Bourret, 1939)	X	-	-	-	-	-	-	-	-	-
Uromastycidae										
Leiolepis belliana (Gray, 1827)	X	-	X	X	X	-	-	-	X	X
Leiolepis rubritaeniata Mertens, 1961	X	-	-	X	-	-	-	X	X	-
Scincidae										
Eutropis longicaudata (Hallowell, 1857)	X	X	X	X	X	X	-	X	X	X
Eutropis macularia (Blyth, 1853)	X	X	X	X	X	X	X	X	X	X
Eutropis multifasciata (Kuhl, 1820)	X	X	X	X	X	X	X	X	X	X
Lipinia vittigera (Boulenger, 1894)	X	-	-	X	X	-	X	X	X	X
Lygosoma quadrupes (Linnaeus, 1758)	X	-	-	X	X	X	X	-	X	X
Riopa angeli Smith, 1938	X	-	-	X	-	-	-	-	-	-
Riopa bowringii (Günther, 1864)	X	-	-	X	X	-	X	X	X	X
Riopa corpulenta (Smith, 1921)	X	-	-	X	-	-	-	-	-	-
Scincella rufocaudata (Darevsky & Nguyen, 1983)	X	X	-	X	-	-	-	-	-	-
Scincella rupicola (Smith, 1916)	X	-	-	X	-	-	-	-	X	-
Sphenomorphus indicus (Gray, 1853)	X	X	X	X	X	X	X	X	X	-
Sphenomorphus maculatus (Blyth, 1853)	X	X	-	X	-	-	X	X	X	X
Sphenomorphus tridigitus (Bourret, 1939)	X	-	-	-	X	-	-	-	-	-
Tropidophorus microlepis Günther, 1861	X	-	-	X	-	X	-	-	X	-
Lacertidae										
Takydromus sexlineatus ocellatus (Cuvier, 1829)	X	X	X	X	X	X	X	X	X	X
Varanidae										
Varanus bengalensis nebulosus (Gray, 1831)	X	X	X	X	X	-	X	X	X	X
Varanus salvator (Laurenti, 1768)	X	X	X	X	X	X	X	X	X	X

Taxa	LaS	LaC	LaN	ViS	ViC	ViN	Cam	TaN	TaC	TaS
Serpentes										
Typhlopidae										
Ramphotyphlops braminus (Daudin, 1803)	X	-	X	X	X	X	X	X	X	X
Uropeltidae										
Cylindrophis ruffus (Laurenti, 1768)	X	X	X	X	X	-	X	X	X	X
Xenopeltidae										
Xenopeltis unicolor Boie, 1827	X	X	X	X	X	X	X	X	X	X
Pythonidae										
Python reticulatus (Schneider, 1801)	X	X	X	X	X	-	X	X	X	X
Python molurus bivittatus Kuhl, 1820	X	X	-	X	X	X	X	X	X	X
Colubridae										
Ahaetulla nasuta (Lacepède, 1789)	X	-	-	X	X	-	X	X	X	X
Ahaetulla prasina (Boie, 1827)	X	X	X	X	X	X	X	X	X	X
Boiga cyanea (Duméril, Bibron & Duméril, 1854)	X	X	X	X	X	-	X	X	X	X
Boiga ocellata Kroon, 1973	X	-	-	X	-	-	X	X	X	X
Boiga multomaculata (Boie, 1827)	X	X	X	X	X	X	-	X	X	X
Calamaria pavimentata Duméril, Bibron & Duméril, 1854	X			X	X	X	X	X	X	X
Chrysopelea ornata (Shaw, 1802)	X	X	X	X	X	X	X	X	X	X
Coelognathus radiatus (Boie, 1827)	X	X	X	X	X	X	X	X	X	X
Dendrelaphis cyanochloris (Wall, 1921)	X	X	-	-	-	-	-	X	-	X
Dendrelaphis pictus (Gmelin, 1789)	X	X	X	X	X	X	X	X	X	X
Enhydris jagorii (Peters, 1863)	X	-	X	X	X	-	X	X	X	X
Enhydris plumbea (Boie, 1827)	X	X	X	X	X	X	X	X	X	X
Gonyosoma prasinum (Blyth, 1854)	X	-	-	-	-	X	-	-	-	-
Homalopsis buccata (Linnaeus, 1758)	X	-	-	X	X	-	X	-	X	X
Oligodon barroni (Smith, 1916)	X	-	-	X	-	-	X	-	X	-
Oligodon cinereus (Günther, 1864)	X	-	X	X	X	X	X	X	-	-
Oligodon inornatus (Boulenger, 1914)	X	-	-	-	-	-	X	X	X	-
Oligodon ocellatus (Morice, 1875)	X	-	-	X	-	-	X	-	-	-
Oreophis porphyraceus vaillanti (Sauvage, 1876)	X	-	X	-	-	X	X	-	-	-
Pareas hamptoni (Boulenger, 1905)	X	X	X	X	X	X	-	X	-	-
Pareas margaritophorus (Jan, 1866)	X	-	-	X	X	X	X	X	X	X
Psammodynastes pulverulentus (Boie, 1827)	X	X	-	X	X	X	X	X	X	X
Psammophis indochinenis Smith, 1943	X	-	-	X	-	-	-	X	X	-
Pseudoxenodon macrops (Blyth, 1854)	X	-	-	X	X	X	-	X	-	-
Ptyas korros (Schlegel, 1837)	X	X	X	X	X	X	X	X	X	X
Ptyas mucosa (Linnaeus, 1758)	X	X	-	X	X	X	X	X	X	X
Rhabdophis chrysargos (Schlegel, 1837)	X	X	-	X	X	X	X	X	X	X
Rhabdophis subminiatus subminiatus (Schlegel, 1837)	X	X	X	X	X	X	X	X	X	X
Sibynophis collaris (Gray, 1853)	X	-	-	X	X	X	X	X	X	-
Xenochrophis flavipunctatus (Hallowell, 1860)	X	X	X	X	X	X	X	X	X	X
Elapidae										
Bungarus candidus (Linnaeus, 1758)	X	X	X	X	X	X	X	-	X	X
Naja siamensis Laurenti, 1768	X	X	-	X	-	-	X	X	X	X
Ophiophagus hannah (Cantor, 1836)	X	X	X	X	X	X	X	X	X	X

Taxa	LaS	LaC	LaN	ViS	ViC	ViN	Cam	TaN	TaC	TaS
Crotalidae										
Calloselasma rhodostoma (Boie, 1827)	X	X	X	X	X	-	X	X	X	X
Ovophis monticola (Günther, 1864)	X	-	-	X	X	X	X	X	-	X
Trimeresurus albolabris (Gray, 1842)	X	X	X	X	X	X	X	X	X	X
Trimeresurus macrops Kramer, 1977	X	X	-	X	-	-	X	X	X	-
Trimeresurus vogeli David, Vidal & Pauwels, 2001	X	-	-	X	X	-	X	-	X	X
Total reptilia	89	51	47	78	61	49	65	64	69	63
% / Southern Laos	-	57.3	52.8	87.6	68.5	55.1	73.0	71.9	77.5	70.8

forest edge, while the other two animals were obtained during the night near a forest stream. Specimen MNHN 2003.3364 was collected while it was foraging on a short tree on the bank of a stream about 2-3 km from human dwellings. Two more females were observed in the same area.

Note. – This species was previously known from Thailand and Vietnam (David et al., 2001; David et al., 2002). Recently, it has been mentioned from Boloven Highlands by Malhotra and Thorpe (2004). Specimen MNHN 2003.3361 has exactly 20 scale rows at midbody, due to a scale row reduction. The ventrolateral line of the adult male exhibits a lower red component (as also found in Vietnamese specimens [unpublished data]), in contrast to Thai specimens in which the ventrolateral stripe is mostly white. The white dorsal dots and yellow eyes in males, the yellowish-green ventrolateral stripe of females and meristic characters are otherwise typical of *Trimeresurus vogeli*.

DISCUSSIONS

As explained above, this survey is preliminary, inasmuch as litttle attention could be given to the hilly, densely forested and protected areas of the western part of Champasak Province. Nevertheless, the collection described in this paper includes 75 species, comprising 22 amphibians (21 Anura, 1 Gymnophiona) and 53 reptiles (1 Chelonian, 25 Lacertilians and 27 Serpentes). Among these species, 17 are new records for the country, including two new species (*Leptobrachium* sp. and *Cyrtodactylus* sp.) that will be discussed elsewhere (Ohler et al., submitted; David et al. submitted):

Amphibians (5): *Kalophrynus interlineatus*, *Kaloula baleata*, *Leptobrachium* sp., *Philautus gryllus* and *Rana morafkai*.

Reptiles (12): *Cyrtodactylus* sp.; *Gonocephalus grandis*, *Riopa angeli*, *Riopa bowringii*, *Scincella rupicola*, *Sphenomorphus tridigitus*, *Tropidophorus microlepis*, *Oligodon barroni*, *Oligodon fasciolatus*, *Oligodon inornatus*, *Oligodon ocellatus*, *Trimeresurus macrops*.

As far as the amphibians are concerned, among the new records, a species with large distribution in south-east Asia, *Kalophrynus interlineatus*, has been confirmed for Laos. This species has fossorial behaviour and thus is rarely observed, but should not be uncommun as it has no particularly restrictive habitat demands. For *Philautus gryllus* the apparent rarity might be due to small adult size and cryptic habit. This species also might be confused with other small sized *Philautus*, but none of them have been recorded to Laos previousely. *Rana morafkai* has been recently described (Bain et al., 2003) and was until then part of a species complex (*Rana livida*) largely distributed in south-east Asia. Its type locality is in adjacent central Vietnam. The new species of *Leptobrachium* Tschudi, 1838 is known only from the Boloven Highlands. The species described from Vietnam and Thailand can easily been distinguished by the colouration of their iris, which has an unique colour in the Boloven *Leptobrachium* species. The most interesting new record is *Kaloula baleata* which was only recently confirmed from southern Thailand. This species has a characteristic colour pattern

and is easily recognised. Its presence in southern Laos is of great biogeographical interest as it confirms a link between peninsular Malaya and more northern parts of the Indochinese region across the Gulf of Siam (see also Pauwels et al., 2003).

Among the 12 reptile records new for Laos, one is an undescribed member of the genus *Cyrtodactylus*, the affinities of which seem to be with the Thai taxa *Cyrtodactylus angularis* (Smith, 1921) and *C. papilionoides* Ulber and Grossmann, 1991. The occurrence of *Gonocephalus grandis* is especially noteworthy, as this species is typically Indo-Malayan, its northernmost known locality being in southern Thailand. Along with *Kaloula baleata* discussed above, this is the second Indo-Malayan species absent from most of Thailand and reappearing in southern Laos. A similar case occurs in several areas of southern Vietnam, both in lowlands and highlands, where purely Indo-Malayan snake species have been recorded (*Python brongersmai* Stull, 1938, *Coelognathus flavolineatus* (Schlegel, 1837), *Liopeltis tricolor* (Schlegel, 1837), *Sibynophis melanocephalus* (Gray, 1834), *Calliophis intestinalis lineata* Gray, 1834, and *Tropidolaemus wagleri* Wagler, 1830; see Orlov et al. 2003). A hypothesis to explain the occurrence of Indo-Malayan species in Laos and Vietnam, based on climatological variation that affected the region of the Gulf of Siam, was suggested in Pauwels et al. (2003).

The other taxa new for Laos can be divided into two groups that we define as "Vietnamese" and "Thai" respectively. In the first group, we include *Riopa angeli*, previously known from three specimens from Vietnam, *Scincella rufocaudata*, *Sphenomorphus tridigitus*, of which we have here the second known specimen, and *Oligodon ocellatus*. The "Thai" group contains *Riopa bowringii*, *Scincella rupicola*, *Oligodon barroni*, *Oligodon inornatus*, and *Trimeresurus macrops*, all more or less widespread in northern Thailand and Cambodia. *Oligodon fasciolatus* is widespread in the region, but was previously confused with *Oligodon cyclurus* (Cantor, 1839). Among other interesting records, *Pseudocalotes poilani* is still known only from the Boloven Highlands. We encountered two specimens (one collected) of this species, previously known from the holotype. The large skink *Riopa corpulenta* is also a rare species, as it was known from the two specimens mentioned in Smith (1935). It was previously recorded from the south of the Annamite Mountains, Attapu Province and Dalat, in South Vietnam. Lastly, the presence in Boloven Highlands of *Oreophis porphyraceus vaillanti* (Sauvage, 1876), a taxon otherwise known from southeastern China, northern Vietnam and northern Laos, shows the presence of "northern" taxa in Boloven Highlands.

The poor state of our knowledge of the herpetofauna of Champasak Province precludes the establishment of a list of amphibians and reptiles. Nevertheless, on the basis of this collection and of references listed in Tables 3 and 4 below, especially Stuart (1999), we can propose a preliminary discussion on the herpetofauna of southern Laos. We arbitrarily define this geographical term as the area encompassing the provinces of Champasak, Attapu, Xekong and Salavan. Our definition is broadly similar to Stuart's (1999) definition of the "South". This area includes the lowlands of the Mekong River and the Boloven Highlands, but also the southern part of the Annamite Mountains. Major protected areas included are (from north to south) Xebang-Nouan NBCA, Xesap NBCA, Xepian NBCA and Dong Khantung PNBCA (see Duckworth et al., 1999 for a complete list). In Table 3, we list species recorded from Xepian NBCA, Boloven Highlands (Sepian), and from other localities of southern Laos, respectively. With such a definition, the herpetofauna of southern Laos is currently composed of 41 amphibian species (40 Anura, 1 Gymnophiona) and a total of 89 reptile species, divided into 10 Chelonii, 1 Crocodylia, 35 Lacertilia and 43 Serpentes.

The amphibian fauna shows affinities to the fauna of southern Vietnam and northern Thailand if measured by the number of species in common. If measured by unique shared species the south Laotian amphibian fauna has elements that are only present in southern Vietnam (*Rana morafkai*), Peninsular Thailand (*Kaloula baleata*) and also northern Vietnam (*Paa microlineata*, but allocation may be wrong as this species

was known only from the types and it is considered to be a synonym of *Paa delacouri*, which is phylogenetically more close to *Limnonectes* than to *Paa*; see Dubois and Ohler, submitted). Several taxa of amphibians will require the collection of series to be identified with confidence and many groups still need revision to have a proper estimate of species range and diversity in Southeast Asia. Our finding confirms biogeographic relationships found between eastern continental and southernmost peninsular Thailand through a route over the present Gulf of Siam as proposed for *Rana nigrovittata* group by Matsui et al. (2001).

Based on the number of species in common, the reptile fauna of southern Laos shows that its strongest affinity with that of South Vietnam (87.6%), followed by the faunas of Central and Eastern Thailand (77.5 %), and Cambodia, North Thailand and South Thailand, with nearly similar values between these three regions (between about 71 and 73 %). The affinities of the reptile fauna hence are identical with those noted for amphibians. It is noteworthy that the affinities with the fauna of Central and North Laos are rather low (57.3 and 52.8 % respectively). This fact may be the result of a poor knowledge of the fauna of these parts of the country. If the comparison is established on the basis of uniquely shared species, excluding wide ranging, ubiquitous species, the south Laotian reptile fauna also contains members restricted to the faunas of South Vietnam (*Riopa angeli*, *Riopa corpulenta*, *Oligodon ocellatus*), Central Vietnam (*Sphenomorphus tridigitus*), North Vietnam and China (*Oreophis porphyraceus vaillanti*), and, as noted for amphibians, of Peninsular Thailand (*Gonocephalus grandis*). Most of these species were obtained in the Boloven Highlands, a wet montain range that seems to act as a refuge for taxa either usually associated with elevated areas in other parts of their range, or restricted to wet forested areas. The presence of species from geographically adjacent areas may be due either to a common biogeographic history, or to a secondary introduction, whereas the presence of species from geographically distant regions should indicate a common biogeographic history. The common presence of species is a consequence of secondary fragmentation of the area by habitat changes due to human activity, such as the deforestation due to the advancement of agriculture from prehistorical times onwards in the flooded plains of central Thailand, or to climatic changes due to natural phenomena. The presence of southern tropical elements in southern Laos is a witness of more extented ares of wet tropical forests in south-east Asia. A hypothesis on the modifications of climatic conditions around the Gulf of Siam appears in Pauwels et al. (2003).

Knowledge of the herpetological fauna of southern Laos will be largely completed by further collections both in lowland and montane areas. It is notewhorthy that only one species of chelonian and no species of Elapidae was collected during this study. As a consequence, it should still considered as highly preliminary. However, this collection gives a limited, although significant, glimpse on the high herpetological richness of Southern Laos.

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GEOGRAPHIC VARIATION AND SYSTEMATICS IN THE SOUTH-EAST ASIAN TURTLES OF THE GENUS *MALAYEMYS* (TESTUDINES: BATAGURIDAE)

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(with eight text-figures)

ABSTRACT.– Geographic variation was studied in the south-east Asian turtles of the genus *Malayemys* (Testudines: Bataguridae). Discriminant function analysis of head-stripe and shell characters reveals a clear pattern of geographic variation that is consistent with the topography of south-east Asia and the poor dispersal abilities of these turtles. Two phenotypically and morphologically distinct groups of *Malayemys* occur allopatrically in lowland areas of mainland south-east Asia, and my data concludes that each should be recognized as a distinct species. Turtles from the Mekong River Basin retain the name *Malayemys subtrijuga* (Schlegel and Müller, 1844), whereas those from the Chao Phraya and Mae Klong river basins, coastal areas of south-eastern Thailand, and the Malay Peninsula are assigned the name *Malayemys macrocephala* (Gray, 1859). *Malayemys macrocephala* has four or fewer nasal stripes (99%) and an infraorbital stripe that is relatively wide at the loreal seam (98% of InfSW/HW=0.07-0.18) and does not extend or extends only slightly superior to the loreal seam (96%). Conversely, *M. subtrijuga* has six or more nasal stripes (89%) and an infraorbital stripe that is relatively narrow at the loreal seam (92% of InfSW/HW=0.02-0.06), extends completely superior to the loreal seam (96%), and usually joins the supraorbital stripe (64%). Female *M. macrocephala* also have relatively longer AnL and relatively shorter Vert5L and PecL than *M. subtrijuga*. Similarly, male *M. macrocephala* have relatively longer PPLL and AbdL, relatively shorter Pleu1L and PecL, and greater RLatK values than *M. subtrijuga*. Both species are potentially threatened by overcollection and habitat destruction, and should be protected as separate taxa of concern. In addition, discriminant function analysis of shell and head-stripe characters suggests that *M. subtrijuga* on Java are derived by human intervention primarily from the Mekong River Basin.

KEY WORDS.– Testudines, systematics, Mekong, Chao Phraya, Mae Klong, *Malayemys subtrijuga*, *Malayemys macrocephala*.

INTRODUCTION

Taxonomy is the foundation of traditional conservation practices (Avise, 1989; Daugherty et al., 1990; Lovich and Gibbons, 1997). Such practices emphasize protection of endangered taxa at the single-species level. Modern conservation programs still adhere to this tradition, because species must be discovered and described before they can be effectively protected (Avise, 1989; Iverson and McCord, 1997; Lovich and Gibbons, 1997). As such, many as yet undescribed species are in potential danger of extinction because of incomplete taxonomy, unrecognized congeneric variation, and/or the lack of formal species descriptions. An alternative to single-species conservation is biodiversity

conservation at the major landscape and entire ecosystem level. This type of strategy protects communities that encompass sensitive as well as non-endangered species, including undescribed species (Lovich and Gibbons, 1997). Until such a strategy can be implemented on a large scale, good taxonomic research remains an important form of protection for unrecognized species.

"One of the worst mistakes we can make in our efforts to protect biodiversity is to allow the extinction of species because of faulty taxonomy" (Lovich and Gibbons, 1997:427). Two excellent examples of this perspective are the tuataras (*Sphenodon* spp.) and the Alabama map turtles (*Graptemys pulchra* complex). In both cases, perceived monotypy forestalled management intervention on behalf of threatened populations of several unrecognized species. Fortunately for both groups, researchers described these unique forms before they became extinct (Daugherty et al., 1990; Lovich and McCoy, 1992; Lovich and Gibbons, 1997).

Malayemys subtrijuga (sensu lato) is another wide-ranging species that has been generally perceived as monotypic (Ernst and Barbour, 1989; Ernst et al., 2000). It is found in lowland freshwater areas of Thailand, Laos, Cambodia, southern Vietnam, the northern Malay Peninsula, and Java, Indonesia. A detailed study of morphological geographic variation has not previously been done for this species and is therefore required to determine whether unrecognized taxa exist among its populations. Such a study is particularly urgent due to the ongoing turtle crisis in south-east Asia; many south-east Asian turtle populations are in rapid decline because of serious pressure from commercial exploitation and habitat destruction (Behler, 1997; Thirakhupt and van Dijk, 1997; van Dijk et al., 2000). If overexploited populations of *M. subtrijuga* (sensu lato) represent undescribed taxa, it is important that they are discovered before they become extinct.

MATERIALS AND METHODS

I examined museum specimens from throughout much of the known range of *M. subtrijuga* (sensu lato). Specimens were grouped into regional geographic samples representing major drainage basins for those on mainland south-east Asia (Kottelat, 1989) and entire islands for those in the Greater Sundas. Sample localities were: Maly = Malay Peninsula including north-eastern and north-western Malaysia and peninsular Thailand; MKl = Mae Klong basin of Thailand; CPhr = Chao Phraya basin of Thailand; SECos = coastal areas of south-eastern Thailand and Cambodia; Mekg = Mekong basin of southern Vietnam, Cambodia, Laos, and north-eastern Thailand; Sumt = Sumatra, Indonesia; Java = Java, Indonesia. The geographic origin of each specimen was based on museum records, and the sample was divided by sex and life stage (juveniles, subadults, adults; see below).

The head-stripe data set consisted of two meristic and one mensural character, whereas the shell data set consisted of one meristic and 28 mensural characters. The number of nasal stripes (NasS) was counted for each specimen. Nasal stripes were defined as the narrow stripes extending downward from the nostrils toward the medial notch of the upper jaw plus those similar stripes running parallel in the nasal region. Partial nasal stripes were counted as entire stripes (Figs. 1 and 2) and partially fused stripes (see Nutaphand, 1979, p. 131) were counted separately. The condition of the infraorbital stripe with respect to the supraorbital stripe and loreal seam (InfLor) was also recorded. The infraorbital stripe was defined as the stripe beginning on each side of the snout just behind the nostrils, curving downward and posteriorly, passing below the orbit to the angle of the mouth. The supraorbital stripe was defined as the stripe extending posteriorly from the tip of the snout along the canthus rostralis and supraorbital rim to the lateral base of the neck. The loreal seam was defined as the seam extending between the nostril and eye on each side of the head, separating the large scale covering the snout and crown and the large scale extending around the upper jaw [i.e., the rhamphotheca] (Figs. 3 and 4). Each specimen was given a numerical score as follows: 1 = infraorbital stripe does not extend superior to loreal seam; 2 = infraorbital stripe extends only slightly superior to loreal seam; 3 = infraorbital stripe extends completely superior to loreal seam but does not join supraorbital stripe; 4 = infraor-

bital stripe extends completely superior to loreal seam and joins supraorbital stripe (Figs. 3 and 4). Finally, the width of the infraorbital stripe was measured at the loreal seam. This character was normalized by dividing it by head width (InfSW/HW) (Figs. 3 and 4).

Dial calipers (accurate to 0.1 mm) were used to take the following straight-line measurements on the shell of each specimen (see Ernst and Lovich, 1986): maximum carapace length (CL); carapace width at the level of the seam separating vertebral scutes 2 and 3 (CW); shell height at the level of the seam separating vertebral scutes 2 and 3 (SH); maximum plastron length (PL); maximum width (APLW and PPLW) and length (APLL and PPLL) of both plastral lobes; minimum bridge length (BrL); maximum width and length of vertebral scutes 1, 2, 3, and 5 (Vert1, 2, 3, 5W and L); maximum width and length of pleural scute 1 (Pleu1W and L); medial seam length of plastral scutes (GulL, HumL, PecL, AbdL, FemL, AnL); and maximum width of gular (GulW), humeral (HumW), femoral (FemW), and anal (AnW) scutes. One meristic character, RLatK, recorded the position (as a proportion) of the right lateral keel as it bisected pleural scute 2. Larger RLatK values corresponded to relatively greater distances from the median keel. The condition of bilateral characters was recorded from the right side of the carapace and the left side of the plastron unless damaged.

Museum acronyms followed Leviton et al. (1985) and Leviton and Gibbs (1988) with the following additions: CRI = Chelonian Research Institute, Oviedo, Florida, USA; KUZ = Kyoto University Zoological Collection, Kyoto, Japan; RH = personal collection of Ren Hirayama, Teikyo Heisei University, Ichihara, Chiba, Japan; ZRC = Raffles Museum of Biodiversity Research, Zoological Reference Collection, The National University of Singapore, Singapore.

Tail morphology was the primary characteristic used for sexual identification in this study. Sexual dimorphism of this character is pronounced in both subadults and adults, with males having much longer and thicker tails (Ernst and Barbour, 1989; Srinarumol, 1995; van Dijk and Thirakhupt, in press). When tail morphology was not available (shell and skeletal material; some dried specimens), information from museum records formed the basis of sexual identification. Srinarumol (1995) distinguished adults from subadults based on the complete development of testes and ovaries, and subadults from juveniles based on tail morphology. Assignment of specimens to appropriate life stages (juvenile, subadult, adult) in the current study was based primarily on the size classes established by Srinarumol's (1995) dissection work.

Only three geographic samples in the current study had sufficient numbers to warrant intersample comparisons. All methods and analyses that follow pertain to samples from CPhr, Mekg, and Java. Geographic variation of head-stripe characters was examined using multivariate techniques. NasS, InfLor, and InfSW/HW (Figs. 1-4) comprised the entire data set. Preliminary analyses indicated that allometric variation and sexual dimorphism were not present in the head-stripe characters (Brophy, 2002), so all specimens within each geographic sample were combined regardless of sex or life stage. Using the three head-stripe characters, the probability of correctly classifying each turtle relative to its predetermined geographic origin (CPhr, Mekg, and Java) was calculated using the cross-validation results of linear discriminant function analysis (PROC DISCRIM; SAS, 1989). Head-stripe differentiation between geographic samples was graphically summarized by plotting canonical discriminant scores (PROC CANDISC; SAS, 1989). Specimens from geographic samples other than CPhr, Mekg, or Java were entered as test data and classified using the head-stripe model described above (PROC DISCRIM; SAS, 1989). Individual medians for the two discrete head-stripe characters (NasS and InfLor) were compared using the Kruskal Wallis test followed by Dunn's post test with $\alpha = 0.05$. Means for InfSW/HW were compared using Analysis of Variance (ANOVA) followed by the Bonferroni multiple comparison test with $\alpha = 0.05$. Assumptions of normality and heterogeneity of variances were tested with Kolmogorov-Smirnov and Bartlett's tests, respectively.

Geographic variation of shell characters was also examined using multivariate techniques.

The twenty-eight mensural shell characters were divided by CL, and the resulting ratios comprised the majority of the data set. RLatK was not divided by CL because it was standardized upon measurement (expressed as a proportion). Preliminary analyses indicated that allometric variation and sexual dimorphism of the shell existed in each of the three geographic samples (Brophy, 2002). To minimize the effects of these factors, only adult and larger subadult turtles (males ≥ 80 mm CL; females ≥ 100 mm CL) were utilized, and males and females were analyzed separately.

Using all 29 shell variables for each sex separately, stepwise selection (PROC STEPDISC; SAS, 1989; significance level for entry and removal = 0.30) was used to obtain a set of potential models that would classify turtles relative to their predetermined geographic origin (CPhr, Mekg, and Java). Final selection of the best model was based on model size and classification accuracy. The best model gave the most accurate cross-validation results (PROC DISCRIM; SAS, 1989) and had no more variables than the number of individuals in the smallest sample. This protocol was designed to select conservative models that had a low number of variables and a high level of classification accuracy.

Using the best model as defined above, the following procedures were performed for each sex. The probability of correctly classifying each turtle relative to its predetermined geographic origin (CPhr, Mekg, and Java) was calculated using the cross-validation results of linear discriminant function analysis (PROC DISCRIM; SAS, 1989). Shell differentiation between geographic samples was graphically summarized by plotting canonical discriminant scores (PROC CANDISC; SAS, 1989). Specimens from geographic samples other than CPhr, Mekg, or Java were entered as test data and classified using the best models described above (PROC DISCRIM; SAS, 1989). Individual means for shell character ratios were compared using ANOVA followed by the Bonferroni multiple comparison test with $\alpha = 0.05$. Assumptions of normality and heterogeneity of variances were tested with Kolmogorov-Smirnov and Bartlett's tests, respectively.

Since there is some question as to the natural occurrence of *M. subtrijuga* (sensu lato) populations on Java (Dammerman, 1929; Ernst et al., 2000; van Dijk and Thirakhupt, in press), one additional set of multivariate analyses was performed on the shell data. Using the same shell character-sets as the best male and female models above, the probability of correctly classifying each turtle relative to its predetermined geographic origin was again calculated using the cross-validation results of linear discriminant function analysis (PROC DISCRIM; SAS, 1989). This time, however, models were based on the CPhr and Mekg samples only. Specimens from the Java sample were subsequently entered as test data and classified using these new models.

RESULTS

Geographic variation of head-stripe characters was evident in *M. subtrijuga* (sensu lato). Using the three character head-stripe model, cross-validation results of linear discriminant function analysis correctly classified 97.73% of turtles from CPhr, 36.36% of turtles from Java, and 76.00% of turtles from Mekg (Table 1). The majority of misclassifications (83%) were Java individuals classified as Mekg and vice versa. The CPhr sample formed a clearly distinct group with considerable confusion between the Java and Mekg groups. This observation was reinforced by the bivariate plot (CV1 vs. CV2) of canonical discriminant scores (Fig. 5). CPhr formed a distinct cluster that had almost no overlap with Java or Mekg, whereas the Java and Mekg clusters strongly overlapped.

When specimens from geographic samples other than CPhr, Mekg, or Java were entered as test data in the head-stripe model, all specimens from Maly, MKl, and SECos were classified as CPhr. Specimens from Sumt were classified as both CPhr (2 specimens) and Mekg (2 specimens).

An examination of individual medians and means for the head-stripe characters also demonstrated the distinctiveness of CPhr (Table 2). For both NasS and InfLor, median values for CPhr were significantly different ($p < 0.001$) from the median values of both Java and Mekg, whereas median values were not significantly different

FIGURE 1: Photographs of *Malayemys macrocephala* (Gray, 1859) illustrating NasS values of 2 (left-USNM 71480) and 4 (right-SMF 52865).

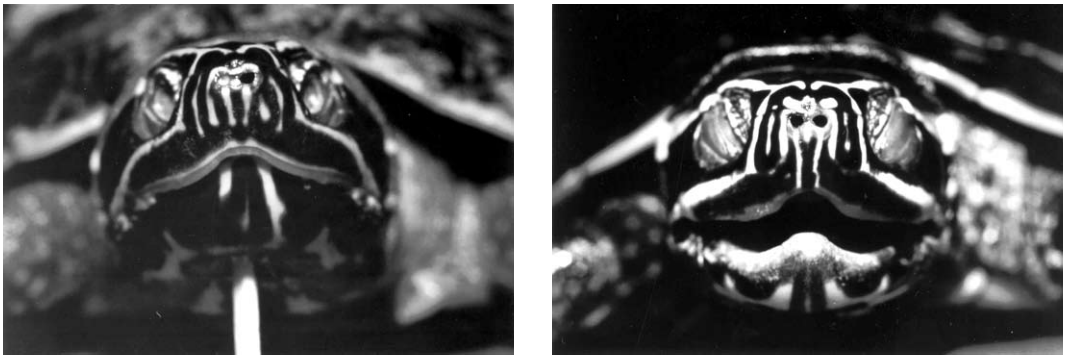

FIGURE 2: Photographs of *Malayemys subtrijuga* (Schlegel and Müller, 1844) illustrating NasS values of 6 (left-MTKD 26087) and 7 (right-ROM 37059). Notice that partial stripes are counted as entire stripes.

between Java and Mekg (Dunn's post test; Table 2). The same pattern emerged for InfSW/HW. Mean values for CPhr were significantly different ($p < 0.001$) from the mean values of both Java and Mekg, whereas mean values were not significantly different between Java and Mekg (Bonferroni multiple comparison test; Table 2). All Kruskal Wallis and ANOVA p values were < 0.0001. In essence, *Malayemys* from CPhr had fewer nasal stripes, lower InfLor values, and wider infraorbital stripes than their Mekg and Java counterparts.

I also had an opportunity to examine photographs of *M. subtrijuga* from Siem Reap (in the Mekong basin), Cambodia (Kurt Buhlmann, pers. comm.; Peter C. H. Pritchard, pers. comm). All animals for which data could be recovered had six nasal stripes (7 specimens), an InfLor value of ≥ 3 (5 specimens), and an infraorbital stripe that was relatively narrow at the loreal seam (5 specimens). These correspond to the head-stripe morphology of other specimens from Mekg.

Geographic variation of shell characters was also evident for female and male *M. subtrijuga* (sensu lato). The best model to classify female turtles relative to predetermined geographic origin correctly classified 88% of all individuals and contained seven of the original 29 shell character ratios. These were Vert5W/CL, PPLW/CL, CW/CL, Pleu1W/CL, Vert3L/CL, AnL/CL, and HumL/CL. Using the seven variable model, cross-validation results of linear discriminant function analysis correctly classified 80 to 91% of females (Table 3). The best model to classify male turtles relative to predetermined geographic origin correctly classified 80% of all individuals and contained five of the original 29 shell character ratios. These were PPLL/CL, AnL/CL, AnW/CL, Vert1L/CL, and Vert5L/CL. Using the five variable model, cross-validation results of linear discriminant function analysis

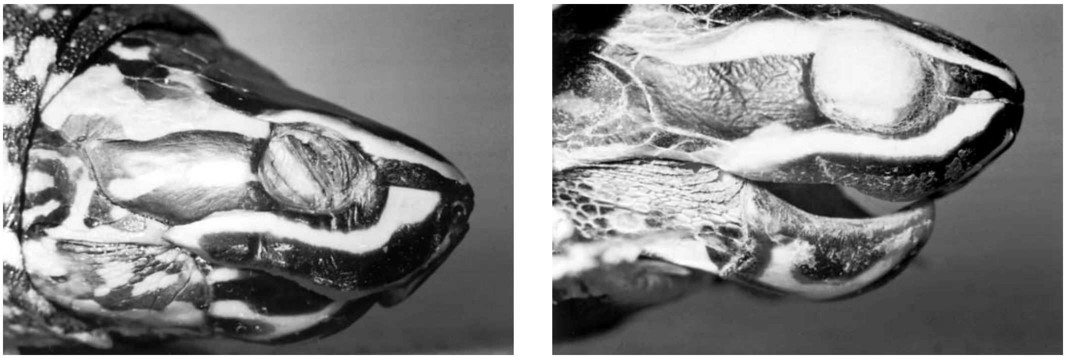

FIGURE 3: Photographs of *Malayemys macrocephala* (Gray, 1859) illustrating InfLor values of 1 (left-GMU 3520) and 2 (right-USNM 71480), and infraorbital stripes that are relatively wide (left-InfSW/HW=0.13; right-InfSW/HW=0.12) at loreal seam.

FIGURE 4: Photographs of *Malayemys subtrijuga* (Schlegel and Müller, 1844) illustrating InfLor values of 3 (left-MTKD 23937) and 4 (right-MTKD 26087), and infraorbital stripes that are relatively narrow (left-InfSW/HW=0.05; right-InfSW/HW=0.03) at loreal seam.

correctly classified 76 to 89% of males (Table 4).

For both females and males, discriminant function analysis demonstrated shell differentiation between the three geographic samples. This differentiation was reinforced by the bivariate plots (CV1 vs. CV2) of canonical discriminant scores (Figs. 6 and 7). Three clusters representing geographic samples were apparent on both the female and male plots, with some overlap between the CPhr and Mekg clusters.

Even though the multivariate analyses of shell character data did not suggest the distinctiveness of CPhr as strongly as the head-stripe data, there were several individual shell characters that reinforced this pattern (Table 5). The mean value of AnL/CL in CPhr females was significantly different ($p < 0.01$) from the mean values of both Java and Mekg, whereas mean values were not significantly different between Java and Mekg. In addition, the mean values of both Vert5L/CL and PecL/CL in CPhr females were significantly different ($p < 0.01$) from those of Mekg (Bonferroni multiple comparison test). The concordance between head-stripe and shell characters was even stronger in males. Five shell characters in males supported the distinctiveness of CPhr over Java and Mekg. The mean values of Pleu1L/CL, PPLL/CL, PecL/CL, AbdL/CL, and RLatK in CPhr males were significantly different ($p < 0.01$ in all but 2 cases) from the mean values of both Java and Mekg, whereas mean values were not significantly different between Java and Mekg (Bonferroni multiple comparison test for all but RLatK; Dunn's post test for RLatK). For female and male comparisons, all ANOVA and Kruskal Wallis p values were < 0.01.

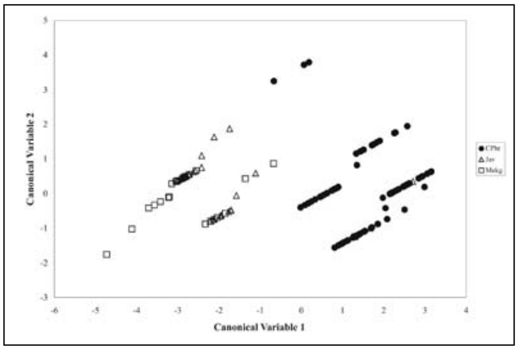

FIGURE 5: Plot of the first two canonical axes for all *Malayemys* based on discriminant function analysis of three head-stripe characters.

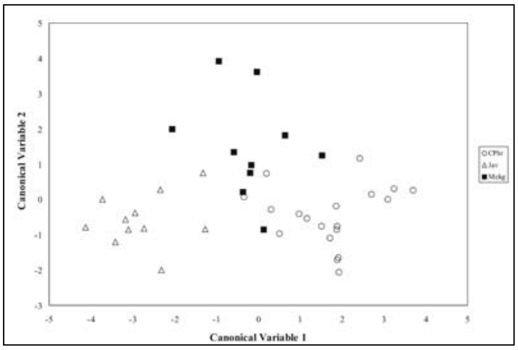

FIGURE 6: Plot of the first two canonical axes for female *Malayemys* based on discriminant function analysis of seven shell character ratios.

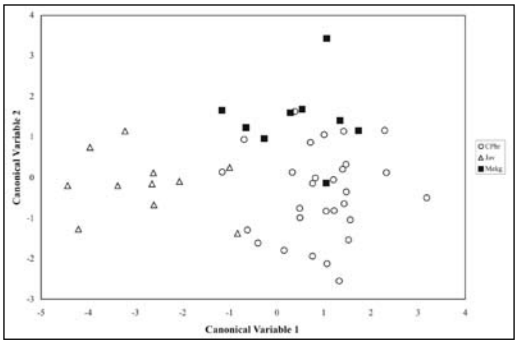

FIGURE 7: Plot of the first two canonical axes for male *Malayemys* based on discriminant function analysis of five shell character ratios.

When specimens from geographic samples other than CPhr, Mekg, and Java were entered as test data in the multivariate shell character models (based on CPhr, Mekg, and Java), all specimens from Maly and SECos were classified as CPhr. Specimens from Sumt were classified as both CPhr (2 specimens) and Mekg (2 specimens). When specimens from the Java sample were entered as test data in the multivariate shell character models based on CPhr and Mekg only, all Java females (11/11) and 91% (10/11) of Java males were classified as Mekg.

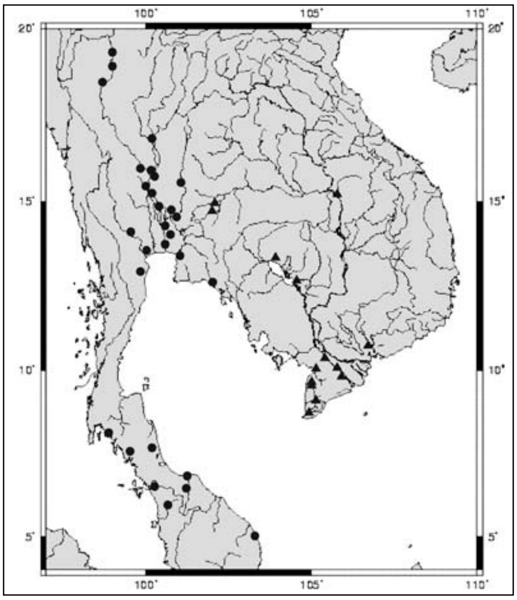

FIGURE 8: Distribution map for *Malayemys subtrijuga* (Schlegel and Müller, 1844) (triangles) and *Malayemys macrocephala* (Gray, 1859) (circles) based on available museum and literature records. See Brophy (2002) for more detailed records.

DISCUSSION

Before the major results of this study are discussed, a few issues regarding the natural occurrence of *M. subtrijuga* (sensu lato) in Indonesia must be considered. The few records that exist for *M. subtrijuga* from Sumatra are almost certainly based on imported specimens or faulty locality data. Several herpetofaunal surveys have failed to locate *M. subtrijuga* on Sumatra (de Rooij, 1915; van de Bunt, 1990; Fritz and Gaulke, 1997; Gaulke et al., 1998; Shepherd, 2000) and current reptile dealers have little or no knowledge of its presence there (Shepherd, 2000). My own results suggest that Sumatran specimens are of mixed origin (see above) and were, therefore, likely introduced or mislabeled. A single record also exists for *M. subtrijuga* on

Borneo (Wetlands International Indonesia Program, Wetlands Database *in* Samedi and Iskandar, 2000). This record is questionable (Samedi and Iskandar, 2000) and if legitimate, is probably based on imported specimens or a misidentification. I found no such museum specimens, and Lim and Das (1999) make no mention of the presence of *M. subtrijuga* on Borneo.

The question as to the natural occurrence of *M. subtrijuga* (sensu lato) on Java, however, is a more complex issue. *Malayemys subtrijuga* has been known from Java for almost 200 years (Temminck and Schlegel, 1834; Schlegel and Müller, 1844; Hoogmoed, 1982). In fact, the syntypes of *M. subtrijuga* (Schlegel and Müller, 1844) were collected in Java's Bantam Province (Temminck and Schlegel, 1834; Schlegel and Müller, 1844; Hubrecht, 1881). There are several lines of evidence, however, that lead me to conclude that *M. subtrijuga* is not native to Java (Dammerman, 1929; Ernst et al., 2000; van Dijk and Thirakhupt, in press). First, recent reports indicate that populations of *M. subtrijuga* on Java are dwindling or extinct (Samedi and Iskandar, 2000; van Dijk and Thirakhupt, in press; Peter C. H. Pritchard, pers. comm.). This may be due in part to the small size of introduced founding populations, but may also be due to extensive long-term habitat alteration on Java (Whitten et al., 1996; Manthey and Grossman,

TABLE 1: Cross-validation results for all *Malayemys* based on linear discriminant function analysis of head-stripe characters. Percentages in parentheses.

	group classification			
Actual group	CPhr	Java	Mekg	Total
CPhr	86 (97.73)	2 (2.27)	0 (0.00)	88
Java	2 (6.06)	12 (36.36)	19 (57.58)	33
Mekg	1 (4.00)	5 (20.00)	19 (76.00)	25

TABLE 2: Head-stripe characters – median and interquartile range (IQR), (range), and [n] – useful in distinguishing CPhr from Java and Mekg. Mean ± 1 SE substituted for median and IQR in InfSW/HW. For NasS and InfLor, medians with different superscripts are significantly different ($p < 0.001$) according to Dunn's post test (InfSW/HW-Bonferroni multiple comparison test, $p < 0.001$). All Kruskal Wallis and ANOVA p values < 0.0001.

Character	CPhr	Java	Mekg
NasS	4.0 (IQR=2)[a] (2-6) [98]	6.0 (IQR=0)[b] (2-6) [37]	6.0 (IQR=0.5)[b] (4-9) [35]
InfLor	1.0 (IQR=1)[a] (1-4) [94]	4.0 (IQR=1)[b] (1-4) [35]	4.0 (IQR=1)[b] (1-4) [25]
InfSW/HW	0.11 ± 0.002[a] (0.06-0.18) [88]	0.05 ± 0.004[b] (0.03-0.13) [33]	0.04 ± 0.003[b] (0.02-0.10) [26]

TABLE 3: Cross-validation results for female *Malayemys* based on linear discriminant function analysis of shell characters. Percentages in parentheses.

	Group classification			
Actual group	CPhr	Java	Mekg	Total
CPhr	17 (89.47)	0 (0.00)	2 (10.53)	19
Java	0 (0.00)	10 (90.91)	1 (9.09)	11
Mekg	2 (20.00)	0 (0.00)	8 (80.00)	10

1997; FAO, 2001; Peter Paul van Dijk, pers. comm.). Second, history indicates that humans have been moving between Java and the south-east Asian mainland for over two thousand years (Whitten et al., 1986; Schwartzberg and Bajpai, 1992). Since *M. subtrijuga* is commonly used for food (van Dijk and Palasuwan, 2000; van Dijk and Thirakhupt, in press) and religious practices (van Dijk and Palasuwan, 2000; Hendrie, 2000; van Dijk and Thirakhupt, in press) by non-Islamic peoples (Whitten et al., 1996), it is conceivable that it was brought to Java for one or both of these reasons. Third, the known distribution of *M. subtrijuga* on Java is primarily limited to port cities on the northern coast. This type of distribution is expected for an introduced species (Inger, 1966). Finally, analyses of ancient river systems suggest that *M. subtrijuga* could not have reached Java from the south-east Asian mainland without passing through either Borneo or Sumatra (Burridge, 1992; Lovich, 1994; Inger, 1999; Voris, 2000), and since it is not found on these islands, an introduced origin is probable.

It is likely that *M. subtrijuga* (sensu lato) is one of the many Indochinese endemics whose populations are primarily found north of the Isthmus of Kra (Lovich, 1994; Rainboth, 1996;

TABLE 4: Cross-validation results for male *Malayemys* based on linear discriminant function analysis of shell characters. Percentages in parentheses.

	Group classification			
Actual group	CPhr	Java	Mekg	Total
CPhr	22 (75.86)	1 (3.45)	6 (20.69)	29
Java	1 (9.09)	9 (81.82)	1 (9.09)	11
Mekg	1 (11.11)	0 (0.00)	8 (88.89)	9

TABLE 5: Shell character ratios – mean ± 1 SE, (range), and [n] – useful in distinguishing CPhr from Java and Mekg. Median and interquartile range (IQR) substituted for mean ± 1 SE in RLatK. For all except RLatK, means with different superscripts are significantly different ($p < 0.01$ in all but 2 cases) according to Bonferroni multiple comparison test (RLatK-Dunn's post test, $p < 0.001$). All ANOVA and Kruskal Wallis p values < 0.01.

Character Ratio	CPhr	Java	Mekg
AnL/CL-females	0.14 ± 0.002^{a} (0.12-0.16) [19]	0.12 ± 0.004^{b} (0.10-0.15) [15]	0.12 ± 0.005^{b} (0.09-0.15) [14]
Vert5L/CL-females	0.19 ± 0.003^{a} (0.15-0.21) [23]	$0.20 \pm 0.005^{a,c}$ (0.16-0.22) [12]	$0.21 \pm 0.004^{b,c}$ (0.19-0.24) [14]
PecL/CL-females	0.12 ± 0.003^{a} (0.09-0.15) [19]	0.12 ± 0.007^{a} (0.06-0.14) [15]	0.14 ± 0.005^{b} (0.11-0.19) [14]
Pleu1L/CL-males	0.24 ± 0.002^{a} (0.21-0.28) [32]	0.26 ± 0.003^{b} (0.24-0.27) [14]	0.25 ± 0.003^{b} (0.23-0.26) [9]
PPLL/CL-males	0.52 ± 0.003^{a} (0.50-0.55) [30]	0.49 ± 0.005^{b} (0.46-0.53) [14]	0.50 ± 0.003^{b} (0.48-0.51) [9]
PecL/CL-males	0.10 ± 0.003^{a} (0.07-0.16) [30]	0.12 ± 0.005^{b} (0.09-0.18) [14]	0.13 ± 0.004^{b} (0.11-0.14) [9]
AbdL/CL-males	0.21 ± 0.003^{a} (0.18-0.23) [30]	0.18 ± 0.004^{b} (0.15-0.22) [14]	0.19 ± 0.004^{b} (0.17-0.21) [9]
RLatK-males	0.25 (IQR=0)[a] (0.20-0.25) [32]	0.20 (IQR=0.05)[b] (0.20-0.25) [14]	0.20 (IQR=0.05)[b] (0.20-0.25) [9]

Inger, 1966, 1999). Lovich's (1994) analysis of the zoogeography of south-east Asian turtles suggested that less than 50% of Indochinese turtles are found south of the Isthmus of Kra. My own results suggest that *Malayemys* from Java are morphologically similar to those from the Mekong River Basin and were, therefore, probably introduced primarily from that region.

It is also possible, however, that populations of *M. subtrijuga* on Java are Pleistocene relicts. One interesting zoogeographical feature of south-east Asia is the correspondence between the monsoon East Javan and monsoon mainland south-east Asian faunas in contrast to the fauna of the rainforest belt (Thai-Malay Peninsula, Sumatra, and Borneo) (Peter Paul van Dijk, pers. comm.). The Banteng (*Bos javanicus*), Javan rhinoceros (*Rhinoceros sondaicus*), and Russell's viper (*Daboia russelii siamensis*) are all examples of species occurring in Java and the monsoon mainland but not the rainforest belt (Lekagul and McNeely, 1977; Peter Paul van Dijk, pers. comm.). Since none of these would have been transported by humans, they are probably relict populations of a wider Pleistocene distribution, when a drier climate created deciduous forests and seasonally fluctuating rivers and floodplains over a much wider region (Lekagul and McNeely, 1977; Whitten et al., 1996; Peter Paul van Dijk, pers. comm.). Even though *M. subtrijuga* (sensu lato) is more likely than the above species to have been transported by man, it is possible that it too is a Pleistocene relict.

Based on the results of this study, I conclude that two distinct groups of *Malayemys* occur on mainland south-east Asia. Populations from central and peninsular Thailand and northern Malaysia (CPhr, MKl, SECos, Maly) differ significantly and consistently from those in eastern Thailand, Laos, Cambodia, and southern Vietnam (Mekg). These groups were clearly separated by univariate and multivariate analyses of both head-stripe (Tables 1-2; Fig. 5) and shell characters (Tables 3-5; Figs. 6-7). *Malayemys* from CPhr, MKl, SECos, and Maly have four or fewer nasal stripes (99%) and an infraorbital stripe that is relatively wide at the loreal seam (98% of InfSW/HW=0.07-0.18) and does not extend or extends only slightly superior to the loreal seam (96%) (Table 2). Females from CPhr, MKl, SECos, and Maly also have relatively longer AnL and relatively shorter Vert5L and PecL than their Mekg counterparts (Table 5). Similarly, males from CPhr, MKl, SECos, and Maly have relatively longer PPLL and AbdL, relatively shorter Pleu1L and PecL, and greater RLatK values than their Mekg counterparts (Table 5). Populations from Mekg, on the other hand, have six or more nasal stripes (89%) and an infraorbital stripe that is relatively narrow at the loreal seam (92% of InfSW/HW=0.02-0.06), extends completely superior to the loreal seam (96%), and usually joins the supraorbital stripe (64%) (Table 2).

The observed differences between these two groups are consistent with the topography of the region and the poor dispersal abilities of *Malayemys*. The south-east Asian mainland is a topographically complex region with many lowlands interspersed between mountain chains and hills. The topography of this area was formed in response to the subduction of the Indian subcontinent under the Asian mainland (Molnar and Tapponier, 1975; Lekagul and McNeely, 1977). This created the Himalayas at the main collision front and buckled other areas around its edges. As a result, the mountain and hill ranges in mainland south-east Asia stretch in a general north-south direction (Molnar and Tapponier, 1975; Lekagul and McNeely, 1977). The two distinct groups of *Malayemys* correspond with separate lowland areas that are broadly separated by mountains at the boundary between the Chao Phraya and Mekong river basins.

Turtles of this genus are slow-moving, poor-swimming, bottom-feeders that exclusively inhabit lowland freshwater areas. They are restricted by hilly areas and associated watershed divides, are unable to ascend streams (Thirakhupt and van Dijk, 1995), and despite intensive searches, could not be found in any stream in hilly areas (van Dijk and Thirakhupt, in press). Because of the poor dispersal abilities of *Malayemys*, the boundary between the Chao Phraya and Mekong basins is sufficient to isolate these two groups, thereby restricting gene flow between them.

The specific events that led to this isolation are unclear. One possible explanation, however, may be found in the reconstruction of former river courses. Gregory (1925) hypothesized that the upper Mekong River was once connected to the Chao Phraya River through the present-day Mae Nam Yom. Essentially, the Chao Phraya and Mekong rivers were different channels in a single huge delta, and/or both were major tributaries of the West Sundaland River (Lekagul and McNeely, 1977; Peter Paul van Dijk, pers. comm.). This hypothesis is supported by the high degree of overlap in fish faunas between the modern Chao Phraya and Mekong basins (Kottelat, 1989). This connection may have joined the two *Malayemys* groups, and its severing may have been the final step in their isolation. The severance of the Chao Phraya from the upper Mekong was probably caused by the Chiang Mai uplift during the early Middle Pleistocene (Lekagul and McNeely, 1977; Peter Paul van Dijk, pers. comm.). Once isolated, divergence may have occurred via natural selection, genetic drift, or founder effect.

The question now arises as to the taxonomic status of these two divergent populations. My goal in this study was to discern evolutionarily independent but genetically cohesive units and to recognize them as taxonomic species (Good and Wake, 1993). There is sufficient evidence (topographical, ecological, and geological) to conclude that the two forms of *Malayemys* identified during this study are allopatrically distributed, and that the likelihood of genetic interchange between them is low. Since these morphologically distinct groups are currently allopatric, they are, by definition, independently evolving entities and should be afforded full species status (Simpson, 1961; Wiley, 1978, 1980; Frost and Hillis, 1990). These groups may have been geographically isolated for only a short time, and they might resume interbreeding if they come into contact in the future. Since knowledge of future events is impossible, however, inferences about past events must suffice (Good and Wake, 1993). Furthermore, it is assumed that the longer these two groups are isolated and the more differences that evolve between them, the more likely it is that they will remain reproductively independent on recontact (Good and Wake, 1993).

A valid species name is available for *Malayemys* from the Mekong River Basin. The three syntypes for *M. subtrijuga* were collected in Java's Bantam Province (former residency in western Java currently known as Banten) by H. Kuhl and J. C. van Hasselt and were sent to the Rijks-Museum (RMNH; currently Nationaal Natuurhistorisch Museum) in Leiden, The Netherlands (Temminck and Schlegel, 1834; Schlegel and Müller, 1844; Hubrecht, 1881). Boie ("1824-1825") incorrectly identified these specimens as *Emys trijuga* Schweigger, 1812 but provided a detailed illustration of one individual (see Hoogmoed, 1982 for discussion of completion date for Boie's manuscript). Temminck and Schlegel (1834) gave a short description of these same three specimens but also identified them as *E. trijuga* Schweigger, 1812. This error was eventually corrected by Schlegel and Müller (1844:30) where they were given the name *Emys subtrijuga*. The three syntypes, one stuffed male and two stuffed females, are currently cataloged as RMNH 6082, 6084, and 6085 (King and Burke, 1997). I have examined these specimens along with Boie's ("1824-1825") unpublished manuscript and all other pertinent literature (Temminck and Schlegel, 1834; Schlegel and Müller, 1844; Hubrecht, 1881), and there is no doubt in my mind that these are the syntypes for *M. subtrijuga* (Schlegel and Müller, 1844).

The identity of the type specimen(s) for *M. subtrijuga* has not always been so clear (Iverson, 1986, 1992; King and Burke, 1997). Iverson (1986:50, 1992:138) listed BMNH 1947.3.4.53 as the holotype for *M. subtrijuga* based on an entry in the BMNH species catalog (King and Burke, 1997). Iverson (1992; *in* King and Burke, 1997) further stated that the catalog entry identified BMNH 1947.3.4.53 as Boulenger's (1889) specimen "m" which was listed as a composite specimen of *Damonia* (=*Malayemys*) *subtrijuga* and *Nicoria* (=*Melanochelys*) *trijuga*. It is clear to me that Iverson (1986, 1992) mistakenly identified BMNH 1947.3.4.53 as the holotype of *M. subtrijuga* based on incorrect information in the BMNH species catalog. I also obtained a

copy of the BMNH species catalog and it clearly states all that Iverson (1986, 1992) indicates. The problem with the catalog, however, is that it is contradicted by earlier published accounts of BMNH holdings.

The entry for Boulenger's (1889) *Damonia subtrijuga* specimen "m" is identical in all respects to the aforementioned BMNH species catalog, with one exception. Boulenger (1889) does not list specimen "m" as a type of *Emys* [= *Malayemys*] *subtrijuga*. This is significant because it was Boulenger's (1889) custom to indicate type specimens where appropriate. He does note, however, that this is the "Specimen mentioned by Gray as *Emys subtrijuga*" (p. 95). Perhaps this is the original source of the error in the BMNH species catalog

A thorough examination of the literature indicates that the above quote probably refers to Gray (1873). In this publication, Gray refers to an "*Emys subtrijuga*" (*Damonia macrocephala* specimen "e"; catalog no. 48,10,31,16) skeleton and shell which were obtained from the Leyden Museum (currently RMNH). The catalog number given by Gray (1873) is an old number for BMNH 1947.3.4.53 (BMNH species catalog). Gray (1873) failed to identify this as a type specimen, which would have been his custom as well.

This issue is further complicated by the fact that BMNH 1947.3.4.53 was apparently obtained from the Leyden Museum (Gray, 1873). Hubrecht (1881) recognized the potential for confusion, so he stated "the type specimens being all preserved in Leyden it [BMNH 1947.3.4.53] could not have been one of these" (p. 49). Based on the above discussion, there can no longer be any doubt that BMNH 1947.3.4.53 is not the holotype for *M. subtrijuga* and that the true syntypes for this species are RMNH 6082, 6084, and 6085.

As stated previously, my results suggest that *Malayemys* from Java are morphologically similar to those from the Mekong River Basin and are considered here as introduced to Java from that region (Tables 1, 2, 5; Fig. 5). I examined the syntypes for *M. subtrijuga* (RMNH 6082, 6084, 6085) and conclude that they are representative of *Malayemys* from the Mekong basin. All three specimens have six nasal stripes, an infraorbital stripe that is relatively narrow at the loreal seam (InfSW/HW = 0.0362, 0.0459, 0.0462), and an infraorbital stripe that extends completely superior to the loreal seam and joins the supraorbital stripe (InfLor = 4). In addition, RMNH 6082 and 6085 were classified as Mekg by linear discriminant function analysis of both shell and head-stripe characters (Table 1; Fig. 5). RMNH 6084 was classified as Mekg by linear discriminant function analysis of head-stripe characters (Table 1; Fig. 5), but was not classified by the shell character model because of missing data. For these reasons, *Malayemys* from the Mekong River Basin and Java retain the name *Malayemys subtrijuga* (Schlegel and Müller, 1844) (Fig. 8). Because of its overall condition and morphology, I designate RMNH 6082 as the lectotype for *M. subtrijuga* (Schlegel and Müller, 1844). I am not going to restrict the type locality of *M. subtrijuga* because there is some question as to the natural occurrence of this species on Java (Dammerman, 1929; Ernst et al., 2000; van Dijk and Thirakhupt, in press).

A valid species name is also available for *Malayemys* inhabiting the Chao Phraya and Mae Klong basins of central Thailand, the coastal areas of south-eastern Thailand, and the Malay Peninsula in southern Thailand and northern Malaysia. The two syntypes for *M. macrocephala* were collected in "Siam" by M. Mouhot and were sent to the British Museum in London (Gray, 1859). Gray (1859) described these two specimens as *Geoclemys macrocephala*. He gave a lengthy description that included the following diagnostic character for this group: "... two close streaks under the nostrils to the middle of the upper jaw..." (Gray, 1859:479). This corresponds with two nasal stripes from the current study. Examination of the accompanying Plate XXI reveals that *Geoclemys macrocephala* also has a relatively wide infraorbital stripe that does not extend superior to the loreal seam. The identity of the syntypes for *M. macrocephala* is not nearly as complicated as with *M. subtrijuga*. Boulenger (1889:95) clearly lists *Damonia subtrijuga* specimens "a" and "b" as "Types of *G. macrocephala*". Gray (1873) identifies the types of *Damonia* [=*Malayemys*]

macrocephala as 59,7,8,4 and 59,7,8,5. Gray's (1873) catalog numbers are old numbers for BMNH 1947.3.4.51-.52 (BMNH species catalog). These are, without question, the syntypes for *M. macrocephala* (Gray, 1859).

I examined the syntypes for *M. macrocephala* (BMNH 1947.3.4.51-.52) and conclude that they are representative of *Malayemys* from CPhr, MKl, SECos, and Maly. Both specimens have two nasal stripes, an infraorbital stripe that is relatively wide at the loreal seam (InfSW/HW = 0.0684, 0.0817), and an infraorbital stripe that does not extend superior to the loreal seam (InfLor = 1). In addition, both specimens were classified as CPhr by linear discriminant function analysis of head-stripe characters (Table 1; Fig. 5). BMNH 1947.3.4.51 was also classified as CPhr by linear discriminant function analysis of shell characters (Table 3). For these reasons, *Malayemys* from CPhr, MKl, SECos, and Maly are assigned the name *Malayemys macrocephala* (Gray, 1859) (Fig. 8). Because of its larger size and overall morphology, I assign BMNH 1947.3.4.52 as the lectotype for *M. macrocephala*. Further, since the type locality for this species was given as "Siam" (Gray, 1859), I restrict the type locality of *M. macrocephala* to Thanyaburi, Pathum Thani Province, Thailand (Chao Phraya River Basin; approx. 50 km NNE of Bangkok; 14.017 N, 100.733 E). Populations of *M. macrocephala* appear to be substantial at this location (Srinarumol, 1995; van Dijk and Thirakhupt, in press) and several specimens from this area are preserved at Chulalongkorn University in Bangkok (CUB 1992.11.10.1-.2, 1999.01.05.15-.18).

In light of the current taxonomic proposals, *M. macrocephala* (Gray, 1859) and *M. subtrijuga* (Schlegel and Müller, 1844) should be protected as separate taxa of concern. Populations of *M. macrocephala* are relatively stable (van Dijk and Palasuwan, 2000; van Dijk and Thirakhupt, in press) and fairly well protected (Thirakhupt and van Dijk, 1995; Sharma and Tisen, 2000; van Dijk and Palasuwan, 2000) in Thailand and Malaysia. *Malayemys subtrijuga* populations, on the other hand, are vulnerable (IUCN TFTSG & ATTWG, 2000) and poorly protected (Hendrie, 2000; Stuart and Timmins, 2000; Stuart et al., 2000; Touch Seang Tana et al., 2000) in Laos, Cambodia, and Vietnam. Population sizes in these areas are severely reduced due to intense harvesting and habitat alteration (Stuart and Timmins, 2000; Touch Seang Tana et al., 2000; van Dijk and Thirakhupt, in press). Fortunately, *M. subtrijuga* in the Mekong basin of north-eastern Thailand enjoy the same protections as their *M. macrocephala* counterparts. The future is worrisome for *Malayemys* populations in south-east Asia. Appropriate conservation measures and additional research are needed to ensure the long-term survival of these species in the region (Thirakhupt and van Dijk, 1995; van Dijk et al., 2000; van Dijk and Thirakhupt, in press).

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SPECIMENS EXAMINED

Malayemys macrocephala: CPhr-AMNH R-92277-79, R-94563; BMNH 1921.4.1.187; CAS 98890, 119939; CUB 1992.11.10.1-.2, 1998.04.05.1, 1999.01.05.15-.18; FMNH 73815, 171927-28, 190336-42; KU 50509-14; MCZ R-20302-03, R-29506, R-43083; MTKD 17098, 17107, 22274-75, 34593; NMW 1322, 29373.5, 29375; RMNH 10374.1-.6, 11367, 14911.1-.2; SMF 42960, 52864-67, 70535; UF 69136, 111443; UMMZ 65138-40, 65142-50; USNM 70363, 71480, 72322-23, 79454, 79499, 101580, 102994, 104335; ZMUC R2505-06, R25233; ZRC 2.72; ZSM 17/1956.01-.12, 55/1956.01-.03; Maly-BMNH 1903.4.13.1; KUZ 36800-01; UF 85286; USNM 22951, 23111; MKl-CUB 1999.01.05.1-.14; SECos-USNM 72212; Sumt-NMW 29376.3-.4; Thailand-AMNH 80924; BMNH 59.7.8.4-.5; FMNH 171915-16, 171926; GMU 3504, 3519-22; MCZ 55149; LACM 8115; NMW 29374.2-.3; UF 85203; UMMZ 128404; Other-CRI 3446, 3807; ZMH R00399-400

Malayemys subtrijuga: Java-BMNH 63.12.4.38, 71.4.10.2; MCZ R-7819; MNHN 1905.57; NMBE 44a/14; NMW 29371.1-.4, 29373.4; RH 33, 140, 142-44; RMNH 3960, 6082, 6084-85, 22213, 28045; SMF 7532-35, 52792, 58097; USNM 43870-71, 44121-22; ZMH R03088; ZMUC R25229-32; ZSM 2/1949; Mekg-BMNH 60.8.28.6, 1861.4.12.15; CRI 3231, 3276, 3442-45, 3447-48, 3451, 3808, 3853-54, 4077; CUB 1991.9.1.2; MNHN 1963.746; MTKD 18811, 22525, 23937, 26087; NMW 29373.3, 29374.1; ROM 37057-66; ZRC 2.2592; Sumt-NMW 29376.1-.2; Other-RMNH 4749.

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SEXUAL DIMORPHISM, ALLOMETRY AND VERTEBRAL SCUTE MORPHOLOGY IN *NOTOCHELYS PLATYNOTA* (GRAY, 1834)

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(with four text-figures)

ABSTRACT.– Sexual dimorphism, allometry, and vertebral scute morphology were studied in the Malayan flat-shelled turtle, *Notochelys platynota* (Gray, 1834). Adult males (mean CL = 238.29 ± 50.68 mm, range 130.5-282.0, n = 16) were, on average, larger than adult females (mean CL = 203.48 ± 52.50 mm, range 125.3-330.0, n = 44). The five largest individuals in the study, however, were females (283-330 mm CL). The SDI value for this species was calculated as -1.17. Sexual dimorphism of the shell was not evident when examined by ANCOVA. The regression slopes of males and females differed significantly (P < 0.05) in only one of 26 characters examined. Allometric growth of the shell, however, was evident in *N. platynota*. Shell shape changed as CL increased proportionally more than shell width, shell height and plastral length (18/26 characters). This allometric growth pattern yields adults with relatively narrower and flatter shells than juveniles. Of 127 specimens examined, 3.9% (n = 5) had five vertebral scutes, 85.0% (n = 108) had six, 10.2 % (n = 13) had seven and 0.8% (n = 1) had eight vertebrals. In specimens with five vertebrals (presumably the ancestral condition), all scutes were large, broader than long, and of similar length. In specimens with six or seven vertebrals, the first four and last vertebrals (Vert6 or 7) were large and broader than long. The smaller supernumerary scutes characteristic of this species were usually found between the fourth and last vertebrals and were occasionally longer than broad (5% of specimens, n = 5). The presence of supernumerary scutes does not affect the relative length of the entire vertebral series, as evidenced by a lack of variation in this character among specimens with five, six and seven vertebrals. Instead, as suggested by an increased width to length ratio of several normal scutes in specimens with six or seven vertebrals, there is a shortening of several normal scutes to accommodate the additional ones. In specimens with six or seven vertebral scutes, the relative lengths of most normal vertebrals (all except Vert1) were noticeably shorter than in specimens with five vertebral scutes. The fourth and last (Vert6 or 7) vertebrals were the shortest of these normal scutes.

KEY WORDS.– Testudines; Bataguridae; *Notochelys platynota*; allometry; sexual dimorphism; vertebral scute morphology.

INTRODUCTION

Notochelys platynota (Gray, 1834), the Malayan flat-shelled turtle, is a medium-sized batagurid turtle reaching maximum sizes of 33-36 cm carapace length (Ernst and Barbour, 1989; Lim and Das, 1999; Ernst et al., 2000). This species shows some secondary sexual dimorphism, with males having slightly concave plastra and thicker tails than the flat-plastroned females (Ernst and Barbour, 1989; Ernst et al., 2000). Sexual dichromatism has also been reported in this species. The carapace of males has a buff to yellow-

brown ground colour that is irregularly mottled with a darker brown pigment, whereas the carapaces of immature individuals and females are more uniformly olive- to reddish-brown (E. O. Moll, pers. comm.). In addition, the head and neck is often much darker (almost black) in adult males (E. O. Moll, pers. comm.), and the nose of males may show a red colouration during the breeding season (Philippen, 1988). Populations of *N. platynota* can be found in clear streams and small rivers, often fast flowing and usually in forested areas (Moll and Khan, 1990; Lim and Das, 1999), from peninsular Thailand southward through Malaysia, Sumatra, and Java to Borneo (Ernst and Barbour, 1989; Ernst et al., 2000). This species is unique in typically having more than five vertebral scutes (usually six or seven). These additional scutes have symmetrical connections with the adjacent pleural scutes and a definite position in the vertebral series (Ernst and Barbour, 1989; Ernst et al., 2000).

Sexual dimorphism and allometry of the turtle shell have been studied extensively (see Mosimann, 1956; Berry and Shine, 1980; Ernst and Lovich, 1986; Gibbons and Lovich, 1990; Ernst et al., 1998 for reviews). Both are important factors in studies of ecology, physiology, nutrition, embryology, morphogenesis, evolution, and taxonomy (Mosimann, 1958; Berry and Shine, 1980; Gibbons and Lovich, 1990). Sexual dimorphism and allometry are particularly important to taxonomy because a detailed investigation of intrapopulational variation is a crucial first step in any study of interpopulational differences. Without such considerations, critical errors in taxonomic judgment are likely to occur.

The purpose of this paper is to examine sexual dimorphism, allometry and vertebral scute morphology in *N. platynota*. Although these aspects have been studied widely in turtles, little attention has been focused on this species. In fact, we are not aware of any previous study that quantifies these for *N. platynota*. *Notochelys platynota* is listed as vulnerable (VU A1cd+2cd) on the 2000 IUCN Red List and is perhaps one of the least known semi-aquatic turtles in all of tropical Asia (Buskirk, 1997). This study is, therefore, an important contribution to the biological understanding of this species.

MATERIALS AND METHODS

We examined museum specimens from throughout the known range of *Notochelys platynota*. Dial calipers (accurate to 0.1 mm) were used to take the following 29 straight-line measurements on the shell of each specimen (see Ernst and Lovich, 1986): maximum carapace length (CL); carapace width at the level of the seam separating vertebral scutes 2 and 3 (CW); shell height at the level of the seam separating vertebral scutes 2 and 3 (SH); maximum plastron length (PL); maximum width (APLW and PPLW) and length (APLL and PPLL) of both plastral lobes; minimum bridge length (BrL); maximum width and length of vertebral scutes 1-7 (Vert1-7W and L); and medial seam length of all plastral scutes (GulL, HumL, PecL, AbdL, FemL, and AnL). The condition of bilateral characters was recorded from the right side of the carapace and the left side of the plastron unless damaged. Museum abbreviations followed Leviton et al. (1985) and Leviton and Gibbs (1988) with the following additions: KUZ = Kyoto University Zoological Collection, Kyoto, Japan; WPM = personal collection of William P. McCord, Hopewell Junction, New York, USA; ZRC = Raffles Museum of Biodiversity Research, Zoological Reference Collection, The National University of Singapore, Singapore.

Tail morphology and plastral concavity were the primary characteristics used for sexual identification in this study. Males have slightly concave plastra and thicker tails than do the flat-plastroned females (Ernst and Barbour, 1989; Ernst et al., 2000). When tail morphology was not available (shell and skeletal material; some dried specimens), information from museum records sometimes formed the basis of sexual identification. All specimens examined were preserved or skeletal, so carapace colour and pattern were not always discernable.

To test for sexual dimorphism, CL was used as the independent variable for regression analyses (least squares method) of other shell characters. Nontransformed data (mm) were utilized for all specimens that had a determinable sex, and males and females were analyzed separately. The regression slopes of each bivariate relationship were compared for males and females

using Analysis of Covariance (ANCOVA), with CL as the covariate and sex as the fixed factor. Significantly different slopes ($\alpha = 0.05$) indicated sexual dimorphism in the characters regressed against CL (Mosimann and Bider, 1960; Mouton et al., 2000). In addition, sexual differences in CL were tested using Student's t-test and expressed by the sexual dimorphism index (SDI) proposed by Gibbons and Lovich (1990), which is calculated as follows: +f/m when f > m; or –m/f when f < m, where 'f' and 'm' denote mean CL for adult females and males, respectively. To minimize the effects of allometric growth, only specimens > 125 mm CL were utilized in these last two analyses. For the t-test, the Kolmogorov-Smirnov test was used to verify normality and an F-test was used to compare variances.

To test for allometric variation, CL was again used as the independent variable for regression analyses (least squares method) of other shell characters. Nontransformed data (mm) were utilized for all specimens regardless of sex or size. Based on preliminary results regarding sexual dimorphism, all specimens (males, females, and juveniles) were analyzed together. The slope and intercept of each regression equation were tested for differences from zero using Student's t-tests. Intercepts that were significantly different from zero ($\alpha = 0.05$) indicated differential growth (i.e., allometry) of the characters involved (Mosimann, 1958; Stickel and Bunck, 1989).

Several aspects of vertebral scute morphology were also investigated. These included the distribution of vertebral scute number, relative lengths of each vertebral scute and the entire vertebral series, width to length ratios for each vertebral scute, and the position and origin of supernumerary scutes in the vertebral series. To verify the identity of the smaller supernumerary scutes (sometimes referred to as extra or additional scutes), relative lengths of all vertebral scutes (length of scute divided by length of entire vertebral series) were compared in specimens with six or seven vertebrals. The relative lengths of the entire vertebral series (length of entire vertebral series divided by CL) were compared among specimens bearing five, six, and seven vertebral scutes. The width to length ratio of each vertebral scute was also compared among specimens bearing five, six, and seven vertebral scutes. Finally, in an attempt to discover the origin of the extra vertebrals in this species, the relative lengths of each normal vertebral scute (Vert1-4 and last vertebral) were compared among specimens bearing five, six, and seven vertebrals.

When parametric assumptions were met, the statistical comparisons above were made with a one-way ANOVA followed by the Tukey-Kramer multiple comparison test (q). Assumptions of normality and homogeneity of variances were tested using the Kolmogorov-Smirnov and Bartlett's tests, respectively. The Kruskal-Wallis test (KW) followed by Dunn's multiple comparison test (mean rank difference = MRD) was used when parametric assumptions were violated. Significance levels were 0.05 in all cases.

RESULTS AND DISCUSSION

Our data indicated that males were, on average, slightly larger than females. Adult males averaged 238.29 ± 50.68 (mean ± 1 SD) mm CL (130.5-282.0 mm, n = 16), whereas adult females averaged 203.48 ± 52.50 mm CL (125.3-330.0 mm, n = 44). This difference in mean carapace lengths was statistically significant ($t = 2.3$, $df = 58$, $P < 0.05$). It is important to note, however, that the five largest individuals in this study were females (283-330 mm CL). The largest individual recorded in this study (BMNH 95.5.14.4), an adult female from Borneo (330 mm CL), is probably the same specimen reported by Boulenger (1912). The SDI value for *N. platynota*, calculated from these same data, was -1.17. SDI values for the entire turtle order range from -1.45 to +2.10 (Gibbons and Lovich, 1990). When compared to other species that have males as the larger sex (mean SDI = -1.10; median SDI = -1.08), *N. platynota* displayed a slightly more negative than average SDI value (Gibbons and Lovich, 1990). It is difficult to draw any firm conclusions regarding overall size differences between the sexes, however, because of relatively small sample sizes, the imbalance of adult male to female sample sizes, and possible collecting bias between samples.

Sexual dimorphism of the shell was not evident in *N. platynota* when examined by ANCO-

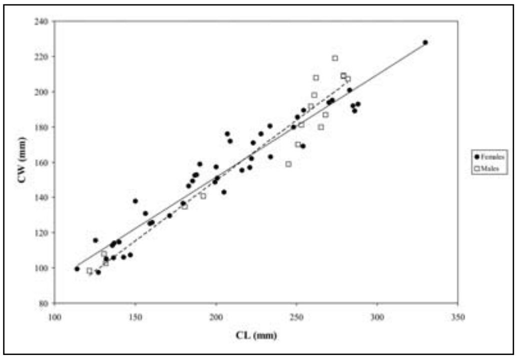

FIGURE 1: Allometry of carapace width plotted as a function of carapace length and sex for *Notochelys platynota* (Female: CW = 35.04 + 0.58CL; Male: CW = 12.43 + 0.68CL; ANCOVA: df = 1,58, F = 4.55, P < 0.05).

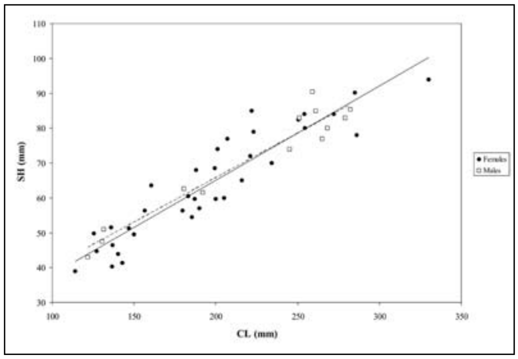

FIGURE 2: Allometry of shell height plotted as a function of carapace length and sex for *Notochelys platynota* (Female: SH = 11.04 + 0.27CL; Male: SH = 14.78 + 0.26CL; ANCOVA: df = 1,44, F = 0.22, ns).

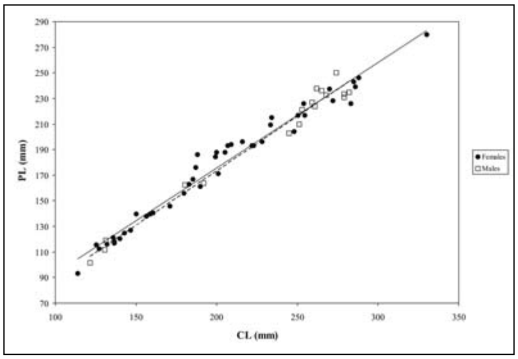

FIGURE 3: Allometry of plastron length plotted as a function of carapace length and sex for *Notochelys platynota* (Female: PL = 10.67 + 0.82CL; Male: PL = 2.61 + 0.85CL; ANCOVA: df = 1,57, F = 0.51, ns).

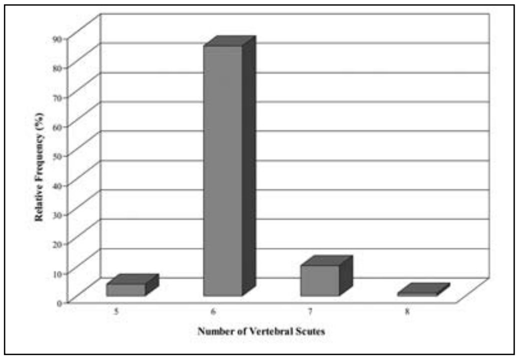

FIGURE 4: Frequency distribution for number of vertebral scutes in *Notochelys platynota* (n = 127).

VA. These analyses indicated that the regression slopes of males and females differed significantly (P < 0.05) in only one of the 26 characters examined (Table 1, Figs. 1-3). For CW (Table 1, Fig. 1), the difference in slopes was barely significant (P > 0.03). This apparent lack of sexual dimorphism in shell shape may also be due to problems with our sample.

Allometric growth of the shell, however, was evident in *N. platynota* (Table 2). Since very little sexual dimorphism was detected, allometric analyses included all specimens regardless of sex or size. Shell shape changed in this species as CL increased proportionally more than shell width (CW, APLW, PPLW), shell height (SH), plastral length (PL and APLL), and several scute widths (Vert2-6W) and lengths (Vert2-4L, Vert6L, BrL, PecL, AbdL).

Allometry of shell characters is a widespread phenomenon among turtles. The allometric pattern that emerges for *N. platynota* is one where both sexes grow proportionally longer than wider or higher. This allometry yields adults with relatively narrower and flatter shells than juveniles. It is critical to emphasize the interrelatedness of allometric growth and sexual dimorphism (or lack thereof). The similar allometric growth pattern of males and females produces adults that lack sexual dimorphism and have the same general proportions. Such a connection has been demonstrated by other authors working with a variety of turtle species (Mosimann,

TABLE 1: Allometric relationships and comparison of regression slopes (ANCOVA) of shell characters versus carapace length among male and female *Notochelys platynota.* All slopes are significantly ($P < 0.0001$) different from zero. For significance levels, ns = $P > 0.05$.

Character	Sex	N	Linear relation y = a + bx (in mm)	R^2	Male vs. Female Slope (b) (H_o: $b_{males} = b_{females}$)
CW	F	45	CW = 35.04 + 0.58CL	0.93	$F_{1,58}$=4.55, p<0.05
	M	17	CW = 12.43 + 0.68CL	0.93	
SH	F	35	SH=11.04 + 0.27CL	0.86	$F_{1,44}$=0.22, ns
	M	13	SH = 14.78 + 0.26CL	0.93	
PL	F	44	PL = 10.67 + 0.82CL	0.97	$F_{1,57}$=0.51, ns
	M	17	PL = 2.61 + 0.85CL	0.98	
APLW	F	44	APLW = 3.33 + 0.40CL	0.93	$F_{1,57}$=1.05, ns
	M	17	APLW =-5.22 + 0.44CL	0.90	
APLL	F	43	APLL = 4.12 + 0.40CL	0.92	$F_{1,56}$=1.25, ns
	M	17	APLL = -7.39 + 0.44CL	0.91	
PPLW	F	43	PPLW = 1.88 + 0.45CL	0.92	$F_{1,56}$=0.04, ns
	M	17	PPLW =-2.61 + 0.46CL	0.92	
PPLL	F	43	PPLL = 6.77 + 0.43CL	0.95	$F_{1,56}$=0.47, ns
	M	17	PPLL = 1.42 + 0.45CL	0.97	

TABLE 2: Allometric relationships of shell characters to carapace length for *Notochelys platynota.* All slopes are significantly ($P < 0.0001$) different from zero. For significance levels, ns = $P > 0.05$.

Character	N	Linear relation: y = a + bx (in mm)	R^2	Significance levels (P) Intercept (a) (H_0: a = 0)
CW	136	CW= 15.12+ 0.68CL	0.98	< 0.0001
SH	118	SH = 3.02 + 0.31CL	0.96	< 0.001
PL	132	PL = -4.07 + 0.89CL	0.99	< 0.001
APLW	132	APLW = -2.33 + 0.42CL	0.98	<0.01
APLL	131	APLL = -3.85 + 0.43CL	0.98	< 0.0001
PPLW	131	PPLW = -3.78 + 0.47CL	0.98	< 0.001
PPLL	131	PPLL = -0.44 + 0.46CL	0.99	ns
Vert1W	110	Vert1W = 0.14+ 0.24CL	0.93	ns
Vert1L	109	Vert1L = -0.25 +0.17CL	0.97	ns
Vert2W	109	Vert2W = 2.94 + 0.27CL	0.97	< 0.0001
Vert2L	109	Vert2L =-1.31+0.19CL	0.98	<0.01
Vert3W	109	Vert3W=1.53+0.28CL	0.97	<0.05
Vert3L	108	Vert3L = -1.95 + 0.20CL	0.98	< 0.0001
Vert4W	108	Vert4W = -2.76 + 0.27CL	0.97	< 0.001
Vert4L	108	Vert4L =-1.63 +0.16CL	0.94	<0.05
Vert5W	109	Vert5W = -3.46 + 0.19CL	0.90	< 0.001
Vert5L	85	Vert5L = -1.43+0.12CL	0.78	ns
Vert6W	105	Vert6W = -3.55+0.25CL	0.93	< 0.001
Vert6L	104	Vert6L = -4.10 + 0.20CL	0.87	< 0.001
BrL	129	BrL = 3.52 +0.31CL	0.97	< 0.0001
GulL	133	GulL =-0.83+ 0.12CL	0.94	ns
HumL	133	HumL = 0.08 + 0.09CL	0.86	ns
PecL	133	PecL = -1.49 +0.19CL	0.95	<0.05
AbdL	133	AbdL =1.27 +0.17CL	0.96	<0.05
FemL	133	FemL = 0.54 + 0.08CL	0.84	ns
AnL	133	AnL =-1.09+ 0.17CL	0.94	ns

TABLE 3: Relative lengths - mean ± 1 SD (median) - of vertebral scutes 1-7 in *Notochelys platynota.* Values are expressed as a percentage of the total length of all vertebral scutes.

Number Vertebrals	Vert1	Vert2	Vert3	Vert4	Vert5	Vert6	Vert7
5 (n=4)	17.8±1.2 (17.4)	20.4±0.2 (20.3)	20.7±1.0 (20.6)	20.5±2.1 (19.8)	20.6±3.3 (21.5)	-	-
6 (n=95)	17.9±1.3 (17.8)	18.9±1.0 (18.8)	18.8±1.1 (18.7)	15.5±1.2 (15.5)	11.4±1.7 (11.3)	17.5±1.8 (17.6)	-
7 (n=9)	17.7±1.5 (16.9)	18.0±1.2 (18.0)	17.1±1.6 (16.6)	12.9±3.5 (14.0)	9.8±2.1 (9.0)	8.8±2.0 (8.4)	15.8±2.0 (14.5)

TABLE 4: Width to length ratio – mean ± 1 SD (median) – of vertebral scutes 1-7 in *Notochelys platynota*. Values calculated by dividing scute width by scute length.

Number Vertebrals	Vert1	Vert2	Vert3	Vert4	Vert5	Vert6	Vert7
5 (n=4)	1.44±0.23 (1.44)	1.42±0.11 (1.38)	1.44±0.14 (1.49)	1.23±0.18 (1.23)	1.18±0.22 (1.12)	-	-
6 (n=95)	1.40±0.16 (1.40)	1.64±0.18 (1.62)	1.65±0.19 (1.62)	1.65±0.18 (1.63)	1.37±0.25 (1.37)	1.33±0.15 (1.30)	-
7 (n=9)	1.39±0.07 (1.39)	1.70±0.24 (1.75)	1.80±0.33 (1.75)	1.87±0.40 (1.74)	2.00±0.52 (1.88)	1.78±0.42 (1.73)	1.52±0.26 (1.60)

TABLE 5: Comparison of relative lengths of vertebral scutes among specimens bearing five, six, and seven vertebral scutes. Mean relative lengths compared with one-way ANOVA followed by Tukey-Kramer (q). Median relative lengths compared with Kruskal-Wallis test (KW) followed by Dunn's (mean rank difference = MRD) when parametric assumptions violated. Pairwise comparisons made between specimens bearing five and six vertebrals (5 vs. 6) and those with five and seven vertebrals (5 vs. 7). a = 0.05 in all cases.

Scute	Variation Significant?	Test Statistic & P value	5 vs. 6 Verts	5 vs. 7 Verts
Vert1	no	F=0.07 P=0.93	n/a	n/a
Vert2	yes	KW=13.16 P<0.01	MRD=43.87 P<0.05	MRD=67.97 P<0.001
Vert3	yes	F=15.55 P<0.0001	q=4.65 P<0.01	q=7.48 P<0.001
Vert4	yes	KW= 16.39 P<0.001	MRD=51.9 P<0.01	MRD=76.2 P<0.001
Last Vertebral	yes	F=9.04 P<0.001	q=4.44 P<0.01	q=5.97 P<0.001

1956, 1958; Mosimann and Bider, 1960; Stickel and Bunck, 1989; Ernst et al., 1998).

Notochelys platynota is unique in normally having more than five vertebral scutes (Ernst and Barbour, 1989; Ernst et al., 2000). Six and seven vertebrals are the most commonly observed numbers. Of 127 specimens examined, 3.9% (n = 5) had five vertebrals, 85.0% (n = 108) had six vertebrals, 10.2% (n = 13) had seven vertebrals, and 0.8% (n = 1) had eight vertebrals (Fig.4). Two specimens with eight and five vertebrals, respectively, had noticeable abnormalities in the vertebral series. The specimen bearing eight vertebrals was severely deformed. The extra scutes were not aligned with the normal ones and had no definite position in the series. These deformed specimens were not used in the statistical analyses that follow.

In specimens with five vertebral scutes (presumably the ancestral condition), all scutes were large (Table 3) and broader than long (Table 4). All vertebrals were of similar length (KW = 6.47, P > 0.10; Table 3) and Vert4 and 5 were the narrowest (Table 4). In specimens with six

or seven vertebrals, the first four and last (Vert6 or 7) vertebrals were large (Table 3) and broader than long (Table 4). Those vertebrals between the fourth and last (Vert5 or Vert5-6), however, were smaller (Table 3) and occasionally longer than broad (5% of specimens, n = 5).

Vert5 was shortest in specimens (95%, n = 91) with six vertebrals (Table 3). A few specimens (5%, n = 5) had Vert4 or 6 as the shortest. In most of these cases (n = 4), however, Vert5 was still the narrowest. Variation among the median relative lengths of all vertebrals was significantly greater than expected by chance (KW = 381.63, P < 0.0001). Vert5 had the smallest median relative length (11.3%) and was significantly different from the median relative lengths of all other vertebrals (Dunn's, P < 0.001 in all cases).

Verts5 and 6 were shortest (67%, n = 6) when seven vertebrals were present (Table 3). A few specimens (33%, n = 3) had Verts4 and 6 as the shortest. Variation among the mean relative lengths of all vertebrals was significantly greater than expected by chance (F = 30.06, df = 62, P < 0.0001). Verts5 and 6 had the smallest mean relative lengths (Table 3) and were significantly different from the mean relative lengths of all other vertebrals (Tukey-Kramer, P < 0.001 in all cases except Vert4 vs. Vert5, P < 0.05 and Vert4 vs. Vert6, P < 0.01). These shorter scutes represent the extra vertebrals characteristic of this species.

Variation among the median relative lengths of the entire vertebral series for specimens with five (median = 99%), six (median = 96%), and seven (median = 93%) vertebral scutes was not significantly greater than expected by chance (KW = 2.08, P = 0.35). This suggests that the presence of supernumerary scutes does not result in an increase in the relative length of the vertebral series (i.e. at the expense of the marginals/cervical/supracaudals). Instead, as we shall see below, there is a shortening of some scutes to accommodate the additional ones.

Variation among the mean or median width to length ratios of Vert2 (F = 3.16, df = 106, P < 0.05), Vert4 (KW = 12.52, P < 0.01), and the last vertebral (F = 7.39, df = 107, P < 0.01) in specimens with five, six, and seven vertebral scutes was significantly greater than expected by chance (Table 4). The median width to length ratios for Vert4 were significantly different between specimens with five and six vertebrals (MRD = -49.22, P < 0.01) and between those with five and seven vertebrals (MRD = -65.53, P < 0.01). The mean width to length ratios for Vert2 (q = 3.5, P < 0.05) and the last vertebral (q = 4.84, P < 0.01), however, were significantly different between specimens with five and seven vertebrals only (Table 4). In all of the above comparisons, specimens with five vertebral scutes had the smallest mean or median length to width ratios. As we shall see below, the increase in the width to length ratios of the normal vertebral scutes in specimens with six or seven vertebrals is due primarily to decreases in their lengths.

In specimens with six or seven vertebral scutes, the widths of all normal vertebrals were seemingly unaffected by the presence of the extra vertebral scutes. With the exception of Vert1, however, their lengths were noticeably shorter than in specimens with five vertebral scutes (Tables 3 and 5), presumably to accommodate the extra scutes. The fourth and last (Vert6 or 7) vertebrals were particularly affected, as these were the shortest of the normal vertebrals in the series (Table 3).

Variation among the mean or median relative lengths of Vert2-4 and the last vertebral in specimens with five, six, and seven vertebrals was significantly greater than expected by chance (Table 5). The mean or median relative lengths of Vert2-4 and the last vertebral were significantly different between specimens with five and six vertebrals (Table 5) and between those with five and seven vertebrals (Table 5). In all comparisons, specimens with five vertebrals had the greatest mean or median relative length.

Based on these evidences, it seems possible that the extra vertebrals in *Notochelys* originated through symmetrical subdivisions of the fourth and last (Vert6 or 7) vertebral scutes along with the shortening of the second and third. However, as suggested by Cherepanov (1989), the extra vertebrals may not be due to subdivisions of existing scutes but rather a result of the *de novo* appearance of supernumerary vertebral

placodes (growth nodes) during the early stages of embryological development. In either case, the scute proportions reported above indicate a specific packing arrangement to accommodate an extra number of growth nodes (P.P. van Dijk, pers. comm.).

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WEIGHT–LENGTH RELATIONSHIPS IN TWO SPECIES OF MARINE SNAKES ALONG THE COAST OF GOA, WESTERN INDIA

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(with one text–figure)

ABSTRACT.– The weight – length relationships and morphometric patterns in two sympatric species of sea snakes, *Lapemis curtus* and *Enhydrina schistosa* were studied along the coast of Goa (western India). In both species, snout-vent length has a strong positive correlation to the weight and tail length. Sexual dimorphism in terms of snout-vent length, body weight and tail length is not evident in both species which supports previous findings in *L. curtus* but contradicts those in the case of *E. schistosa*. The study successfully shows a need for long-term study and an appropriate sampling design.

KEY WORDS.– Sea snakes, morphometry, *Lapemis curtus*, *Enhydrina schistosa*, sexual dimorphism.

INTRODUCTION

Within reptiles, body size is an important life history trait that influences microhabitat type, diet, vulnerability to predators and reproductive success (Calder, 1984; Blueweiss et al., 1978). In snakes, differences in mean body size can result in interspecific variation in ecology (Shine, 1994). Weight - length relationships have been demonstrated in many species of snakes (Kaufman and Gibbons, 1975; Guyer and Donnelly, 1990; Das, 1991). In two thirds of the snake species for which data are available, female snakes grow longer and consequently weigh more than males (Shine, 1993). This is also true in sea snakes (Heatwole, 1999; Shetty and Shine, 2002).

Sea snakes are commonly encountered as by-catch in various fishing activities, yet there is little published information on allometric relationships of most species. Both *Lapemis curtus* and *Enhydrina schistosa* (family Hydrophiidae) are widely distributed species of sea snakes (Minton, 1975). *L. curtus* occurs in the Persian Gulf, Indian Ocean, South China Sea, Straits of Taiwan, Indo Australian archipelago, the Philippines and Australia (Minton, 1975). *E. schistosa* is known from the Indian Ocean, the northern coast of Australia and the South China Sea (Voris et al., 1978) and is known to be the most common species along the coast of India (Daniel, 2002). Studies on their morphometry dates back to the time of Smith (1943). In this paper, we examine the weight - length relationships and the difference between sexes in *L. curtus* and *E. schistosa*, encountered as by-catch in trawls along the Goa coast.

MATERIALS AND METHODS

Study area.- The study was undertaken along the coast of Goa, located on the central west coast of India between 14° 54' to 15° 48'N and 73° 40' to 74° 20'E. It has a 105 km coastline and the wide continental shelf has a 50 m contour depth at 35 km from the coast (Modassir and Sivadas, 2003). The area of the continental shelf (up to 100 fathoms) is 10,000 sq. km (Jhingran, 1991). The sea bed consists of silty clay up to 50 m and sandy silt from 50 to 100 m. The coastline is influenced by three seasons, namely the southwest monsoon (June- September), post monsoon period (Oct-Jan) and fair weather period (Feb-May). On average, Goa receives an annual rainfall of about 1,200 mm. The air temperature fluctuates between 22-38°C with 80% humidity (Modassir and Sivadas, 2003).

Methods.- Sea snakes were collected between November 2002 and April 2003, as a bycatch (see Milton, 2001) during commer-

cial trawl fishing in the near shore waters off Goa (Biswas, 1996). Four major fishing bases, Chapora, Malim, Vasco and Betul located along Chapora, Mandovi, Zuari and the Sal rivers respectively were sampled. The trawlers departing from these fishing bases would sample areas adjacent to their mouths and they thus served as different sampling grounds. These trawl bases were assigned randomly to different dates and one particular trawler was accompanied to examine sea snakes. The number of trawls conducted in the four trawl bases, Chapora, Betim, Vasco and Betul were 42, 63, 50 and 39, respectively. Voucher specimens were collected and catalogued in the Vertebrate Museum of the Wildlife Institute of India. Morphometric data were recorded for 192 and 34 individuals of *L. curtus* and *E. schistosa* respectively that were captured in trawl nets from a total of 194 trawls. Snout to vent length (SVL) and tail length (TL) were taken to the nearest 0.5 cm with a steel Freeman tape and weight (Wt) of all snakes were measured to the nearest gm using a Pesola™ Scale within 30 min after the catch was spread on board. The dead snakes (N = 137) were dissected on board to identify the sex. The live ones (N = 89) were gently pressed on the vent in order to protrude the hemipenis.

The morphometric variables were first subject to log normal transformation and scatter plots were made to depict the relationships between snout-vent length and tail length and weight in the case of *L. curtus* and *E. schistosa*. The regression equations were fit on the data points and the regression line was forced through the origin (Sokal and Rohlf, 1995). The coefficients of variation were computed for each morphometric measurements. The statistical analysis was carried out using SPSS 8.0 (SPSS Inc). Mann Whitney U tests were employed to test whether the coefficients of variation in the morphometric measurements in males and females were significantly different at $\propto = 0.05$ level. The Sexual Size Dimorphism (SSD), a measure of degree of sex difference in body size, was quantified by dividing the mean size of the larger sex by the mean size of the smaller sex (Gibbons and Lovich, 1990).

RESULTS

In total 51 and 141 in *Lapemis curtus,* and 11 and 23 in *Enhydrina schistosa* were males and females respectively. In *L. curtus* and *E. schistosa* it was observed that the SVL explains most of the variation in Wt and TL (Table 1). There was no obvious sexual dimorphism observed in the species. The Sexual Size Dimorphism (SSD) value calculated was 0.98 in *L. curtus* and 0.97 in *E. schistosa*. The frequencies of snakes in different size classes were normally distributed in both sexes and species (Kolmogorov Smirnov test for normality; $p > 0.05$). The sex ratios in both species were highly biased towards females. It was observed that in both species the largest and the smallest individuals were females (Fig. 1). The coefficient of variation of each morphometric variables such as weight was higher in females than in males of both species (Table 2). However the values were not significantly different in males and females of both species (Man Whitney U test, U = 8.000, N = 11, 2 tailed P = 0.201). Evidence from a study, suggests that the long history of trawling in this study hasn't caused selective mortality of males and females of a larger size.

DISCUSSION

Our data conforms to the broad body size-weight relationship observed in many other snake species (Das, 1991; Kaufman and Gibbons, 1975; Guyer and Donnelly, 1990). Body size did not vary among sexes in both species. Lack of sexual dimorphism in size among sea snakes is an exception. Only *L. curtus* and *Emydocephalus ijimae* exhibit such similarity among the sexes in 29 species of sea snakes (family Hydrophiidae) examined (Heatwole, 1999). Body size and sex ratios have theoretical relationships (Slatkin, 1984). Often population with sexual dimorphism manifest biased sex ratios. In sea snakes TL and SVL are important fitness traits and are under strong selection pressure in sea snakes, which play an important role in reproduction (Shine, 1993; Shine and Shetty, 2001). It is interesting to note that no such relation was found in the populations studied. Body size was not dimorphic among the sexes in *L. curtus*, and probably males and females attained similar siz-

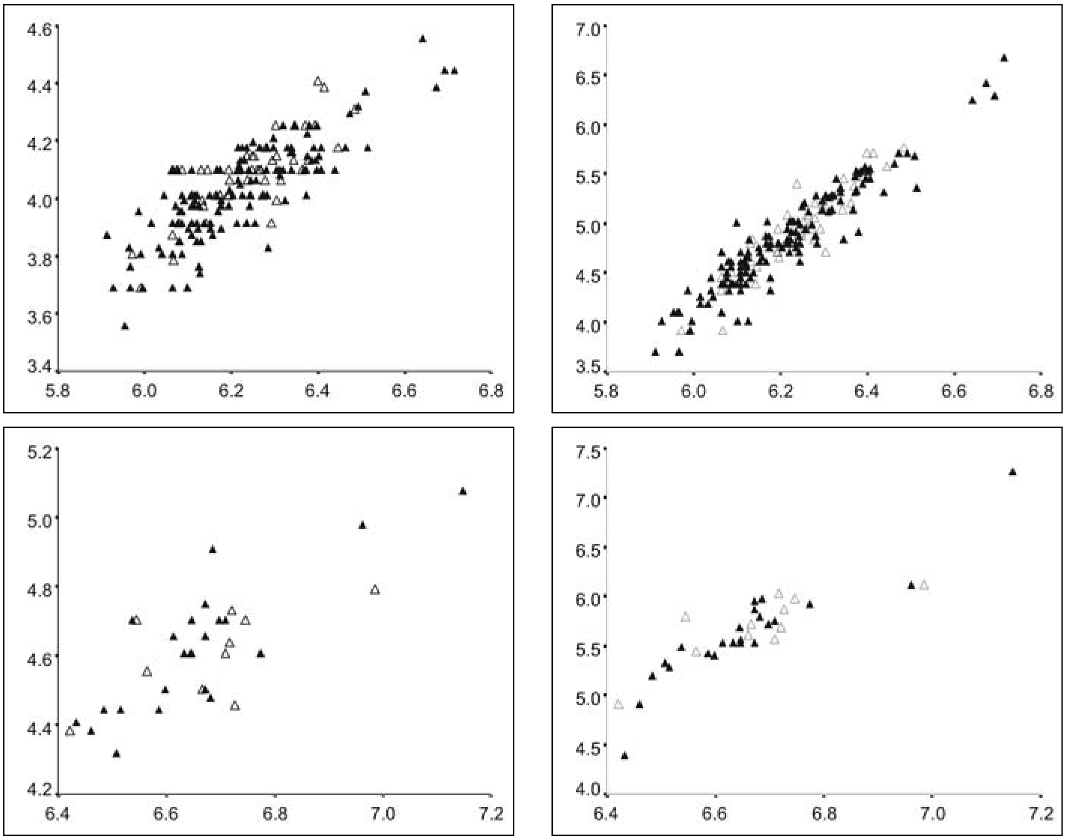

FIGURE 1: Allometric relationship of tail length (top left and right), weight of snake (bottom left and right) with snout-vent length in *Lapemis curtus* and *Enhydrina schistosa* sampled along the Goa coast between November 2002 and April 2003.

TABLE 1: Data on regression of snout-vent length (SVL) to body weight (Wt) and tail length (TL) with regression line forced through the origin.

Sea snake species		R2	F	df
Lapemis curtus	Wt to SVL	0.993	28990	190
	TL to SVL	0.999	300323	191
Enhydrina schistosa	Wt to SVL	0.996	8621	34
	TL to SVL	0.999	35928	34

TABLE 2: Mean and coefficient of variance of different morphometric characters in males and females of (a) *Lapemis curtus* and (b) *Enhydrina schistosa* along the coast of Goa between November 2002 and April 2003.

	Male		Female	
	Mean	CV	Mean	CV
a. *L . curtus* (N = 51) (N = 141)				
SVL	512.76	11.64	504.42	16.46
Wt	148.82	43.02	145.37	69.86
TL	59.56	13.52	56.28	17.21
b. *E. schistosa* (N=11) (N=23)				
SVL	802.36	14.64	783.52	17.77
Wt	310	28.75	318.47	80.02
TL	97	17.85	102.82	20.43

es at maturity (Heatwole, 1999). Our finding on *Enhydrina schistosa* population contradicts an earlier study on the species in Malaysia, where it was found that females are larger and heavier than males (Voris and Jayne, 1979). The skewed sex ratios observed during this short study does not reflect the temporal and spatial variability that is inherent in populations of the species studied elsewhere (Lemen and Voris, 1981). Skewed sex ratio such as the one presented here for *E. schistosa* could be due to a function habitat selection by the sexes (Lemen and Voris, 1981) and the bias in sampling certain areas using trawlers.

Since TL, SVL and Wt are strongly influenced by the growth rate, it would be very difficult to draw conclusion on their sexual dimorphism without long term studies since it is known that growth at maturity stabilizes on these characters (Madsen and Shine, 2001). Growth at maturity is also influenced by annual variation in the habitat and prey availability (Madsen and Shine, 2000).

The data collected during this study also revealed that mortality was biased towards smaller individuals rather than larger ones in both sexes and species. Therefore the data collected through morphometry from this study were probably not influenced by trawl related mortality in the past. Female snakes showed large variation in their morphometric variables where in, it was found that the longest and heaviest and the smallest and lightest in *Lapemis curtus* were females. It is possible that the observed ranges in size was obtained from samples and therefore reflect the differences in sampling the sexes rather than real differences in their populations. Alternatively, this could have been caused due to differential growth rates, resulting in females attaining larger sizes at maturity (Shine, 1993). Though differential growth rates can account for a larger body size of females, the occurrence of females smaller than males in the population is left to speculation. A detailed study on the reproductive biology of the species would provide an insight into the mechanism that governs these patterns.

ACKNOWLEDGEMENTS

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COMMENTS ON THE NARROW-HEADED SOFTSHELL TURTLE (*CHITRA CHITRA*) (TESTUDINES, TRIONYCHIDAE)

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(with one text-figure)

ABSTRACT.– In the aftermath of McCord and Pritchard's ("2002" 2003) revisionary account of the genus *Chitra*, we provide some additional comments concerning Nutphand's two descriptions of *Chitra chitra* and propose that the name-bearing type be considered a lectotype (instead of a holotype). We also comment on the antebrachial scalation (pattern and kind of "scales" on forelimb) that supports the recognition of the subfamily Chitrinae, and on some new distributional information.

KEY WORDS.– Reptilia, Testudines, Trionychidae, Chitrinae, *Chitra chitra*, *Chitra indica*, *Pelochelys* sp., Thailand, Sulawesi.

INTRODUCTION

A descriptive account of *Chitra chitra* seeded in the early 1990s (including personal conversation of authors with Wirot Nutphand in 1993) slowly progressed to a provisional manuscript, which then languished awaiting resolution of some queries. Most of the descriptive information has been adequately incorporated in McCord and Pritchard's ("2002" 2003) systematic review of *Chitra*, who recognized three species, *C. indica, C. vandijki*, and *Chitra chitra* with two subspecies (taxonomic conclusions supported by molecular data, Engstrom and McCord, "2002" 2003). We elaborate on Nutphand's two Thai descriptions of *Chitra chitra*, comment on antebrachial scalation (*Chitra* and *Pelochelys*), and note a new record of occurrence for *C. chitra* in Thailand. Some fossil trionychid shell fragments from Sulawesi that have on occasion been reported as *Chitra* are also discussed.

It should be noted that among the many trionychid generic homonyms, one is *Chitra*; fortunately, *Chitra* Gray, 1844, is senior to *Chitra* Chamberlin, 1930 (Scorpionida). Also, there is no uniform transliteration system for the spelling of the family or surname of the author of *C. chitra*; although "Nutaphand" (1979, Turtles of Thailand) is well-known and acceptable, we have chosen "Nutphand" that corresponds more closely to the Thai, and as spelled (and seemingly preferred) on his personal business card (and hand-printed by him on reverse side) given to RGW in 1993.

Museum eponyms used in the text are as follows: BMNH (The Natural History Museum, London); CUMZ(R) (Museum of Zoology-Reptile Collection, Chulalongkorn University, Bangkok); RMNH (Rijksmuseum van Natuurlijke Historie [at present, Nationaal Natuurhistorisch Museum], Leiden); SMF (Senckenberg Museum, Frankfurt am Main); and ZSI (Zoological Survey of India, Kolkata).

NUTPHAND'S DESCRIPTIONS OF *CHITRA CHITRA*

Nutphand's concept of *Chitra* in Thailand was doubtless based on several specimens that were either casually observed or came into his possession from time to time through animal traders (actual number of specimens studied or observed unknown).

Nutphand initially discussed these turtles as *Chitra indica* (1979) and utilized photographs of three different Thai specimens (see below). His familiarity with Thai *Chitra* coupled with subsequent awareness of certain features of some *Chitra* specimens from India, in large part

based on three specimens imported from India in the 1970s (Nutphand, pers. comm. to PPvD, in litt. to RGW, 12 March 1993), prompted taxonomic recognition of the Thailand population. Nutphand (1986) referred to the Thailand specimens as *Chitra chitra chitra* and (1990) as *Chitra chitra*, but without specific notation as a "new species." Nutphand's 1986 and 1990 descriptions utilized two of the same three specimens (photographs) that he employed in 1979. Corresponding years and photographs are as follows (brackets indicate unnumbered pages): 1) 1979:160, Fig. 127 (portrait, color); same in 1990:[104]. 2) 1979:160, Fig. 128 (head-neck, dorsal and side views); same in 1986:[65] (dorsal view entire specimen). 3) 1979:170, Fig. 142 (large, dissected female, belly-up with eggs, color); same in 1986:[70], and 1990:[97]. In discussions below, these illustrations are indicated only as "photo 1, 2, or 3." Nutphand (1979:62) mentioned the gravid female ("photo 3") as "captured in Thasao Village, Kanchanaburi Province"...[lower Khwae Yai]..."with a carapace 111 cm long, 80 cm wide, and weight of 108 kgs." The turtle depicted in "photo 1" (copied in McCord and Pritchard, "2002"2003:18, Fig. 2, left) is from the Khwae Noi with a carapace length of about 30 cm (pers. convers., Nutphand and authors). Thus, the same specimens (probably several, but three on permanent record as photographs) apply to Nutphand's concept and descriptive information of Thai *Chitra* in 1979, 1986, and 1990 (despite name changes). McCord and Pritchard ("2002"2003) noted vagaries in the use of names and other nomenclatural aspects.

Nutphand nomenclaturally occupied the names *Chitra chitra chitra* (1986) and *Chitra chitra* (1990) for the population in Thailand by mentioning characters "purported to differentiate the taxon" [ICZN, 1999, Art. 13.1.1] as ruled for available names after 1930. Nutphand perceived *Chitra chitra* as of larger size and having a paler color and brighter pattern than *C. indica*. His descriptions were published in a journal whose title translates as "Thai Zoological Magazine." This journal, privately published in the Thai language by the Thai Zoological Center (Siam Farm Zoological Garden and Pata Zoo), Bangkok, has a limited distribution without subscription. Pamphlets are issued separately and irregularly with only the first page numbered, and are eventually bound into annual volumes; individual pamphlets and bound volumes are obtainable by purchase. The title page of each pamphlet, at least recent numbers (1990 description, but not those bound as volume 1 for 1986), bears the volume and number, and month and year of issue (Buddhist Calendar [year less 543 = Christian Era]); pamphlets are numbered consecutively regardless of volume number. Volumes 1, 2, and 3 each bear a different "ISBN" number, whereas volumes 4, 5, and 6 have the same "ISSN" number (see Nutphand's 1986 and 1990 citations in Literature Cited). Since these two papers are not readily available to most colleagues, English translations of selected comments are quoted below. Some passages in the 1986 account (unnumbered pages 64-70) are in McCord and Pritchard ("2002"2003:16).

[1986, p. 64]

Two centered headings of "Manlai" [best translated as striped] and "The World's Largest Soft-shelled Turtle." The entire lengthy text is not quoted. In the initial paragraph on page 64, Nutphand briefly discusses groups of turtles in general terms, terminating with "The last group are the softshells, which have a flexible shell without scutes. The legs are paddle-like, and no hard scales cover the legs. Examples are Ta Pab Gaam Daeng (Red-cheeked Soft-Shelled Turtle) and Manlai (Kanburien Giant Soft-shelled Turtle)."

"'Manlai' is a turtle in the soft-shelled group, it has a leathery skin, the margin is made of cartilage so it is flexible. There are no horny shields. Thai people call this group 'Ta Pab' or 'Ta Pab Nam'." [end of page 64].

The entire page 65 is occupied by "photo 2" (see above). The caption reads only

"'Manlai' *Chitra chitra chitra*." In the first paragraph on page 66 Nutphand mentions the four trionychid species in Thailand, noting scientific names and local Thai names; he notes "another species is Ta Pab Hua Kob, Griu Dao or Grau Khieo, *Pelochelys bibroni* [= *P. cantorii*]; and the last species is Manlai, Ta Pab Manlai, Griu Lai or Grau Daeng, *Chitra chitra*." The

local names Griu and Grau, translated as "Giant Softshell", are exclusively used for *Chitra* and *Pelochelys*.

"'Manlai' (*Chitra chitra*) is the largest softshell inhabiting Thailand and is assumed to be the largest softshell in the world."

"'Manlai' is found only in the Khwae Noi and Khwae Yai rivers of Kanchanaburi Province and in the Mae Klong river of Ratburi Province." Nutphand then discusses dimensions of large individuals, noting "One of the largest was found in B.E. 2510 [1967], which...weighed up to 152 kg, its carapace length was 123 cm." This kind of information continues on to page 67 along with data on egg-laying behavior, clutches of eggs, and food. The epithet *chitra* is nomenclaturally occupied in a short paragraph on page 68 as follows:

"The genus *Chitra* is the genus of 'Manlai'; there are two subspecies, the first one is *Chitra chitra chitra*, the second is *Chitra chitra indica.* These 2 subspecies live in India, Burma and Thailand. *C. c. indica* is assumed to inhabit India, its full adult size is smaller than that of 'Manlai'; additionally, *C. c. indica* has a brownish green or greyish green color. The adult size of 'Manlai' is much larger, it has a very flat and broad shell, and its color is brown from young animal to adult size, with very clear stripes. The main character of *C. c. chitra*, as mentioned above, should make this species the principal species in the genus."

The remainder of the text on page 68 and 69 (half page) is concerned with the rarity of the species and some reasons for its endangerment. Nutphand again notes (p. 68) that "It lives only in a small area, the Khwae Noi and Khwae Yai rivers of Kanchanaburi Province and Mae Klong river of Ratburi Province, and has never been seen in any other place in nature in Thailand." Only "photo 3" occurs on page 70 (captioned "Eggs of one female Manlai with a weight of 108 kg.").

The 1990 account (unnumbered pages 103-104) is included in a 12-page pamphlet wholly dealing with softshelled turtles native to Thailand. The translation of the entire text dealing with *Chitra* is quoted below.

[1990, bottom p. 103]

"5. Ta Pab Manlai, Griu Lai, Grau Daeng.
Kamburien [sic] Giant Soft-Shelled Turtle
Chitra Chitra, Gray." [end of page 103].

"Photo 1" (see above) occupies the upper part of page 104. The text on page 104 begins "The Kanburien Giant Soft-Shelled Turtle is a very big species, the biggest in the world. Among the Chelonia the species with a greater carapace length is the Leatherback Turtle (*Dermochelys coriacea*) which is a marine turtle and not a softshell."

"This species occurs in the Mae Klong in Ratchaburi [Province] and the Khwae river in Kanchanaburi [Province]. Adults have a carapace width of up to 100 cm and a length to 140 cm, and a weight up to 120 kg."

"Dorsal carapace color is faded brown, yellow-brown, with irregular pale brown markings. The pattern varies somewhat between individuals. The neck bears five lines, the posterior end of the carapace shows a pattern resembling a camouflage pattern, which varies. The ventral side is somewhat pinkish white."

"There are two species; the species found in Thailand has characteristics as described above, they are larger than animals from India, and have a very bright pale color, and should therefore be called *Chitra chitra*; those in India are smaller and have a carapace color that is medium olive, and these are named *Chitra indica*."

All of the material available for Nutphand's description of *Chitra chitra* is lost or destroyed (pers. convers., Nutphand and authors). Other than illustrations, Nutphand (1986, 1990) failed to mention or indicate any specific specimen as a type specimen. As previously mentioned, Nutphand's concept of *Chitra* from Thailand was applied as a generalized blanket description in 1979 (as *C. indica*), and 1986 and 1990 (with name changes), and based on several specimens, three of which were depicted in illustrations (syntypes). One of these depicted specimens ("photo 2") in Nutphand (1986:[65]) was copied in McCord and Pritchard ("2002" 2003:18, Fig. 2, right) and treated as the holotype of *Chitra chitra*. Since we regard the first usage of *Chitra chitra* as not based on a single specimen (holotype), we favor designation of their name-bearing type as a lectotype (the other

figured specimens, "photos 1 and 3" see above, as paralectotypes).

ANTEBRACHIAL SCALATION

McCord and Pritchard ("2002" 2003:26, Fig. 4 and Table 1) commented on antebrachial scalation of *Chitra*, referring to sharp-edged scales as "lamellae" and completely smooth scales "round-edged structures" as "pseudodigits." However, those terms are combined in reference to the single large scale (not two separate scales) that is partly smooth and partly cusped (depicted in their Fig. 4; also here in Fig. 1). Generally their distinction of more "lamellae" (3 or 4) in *C. indica* [and *C. vandijki,* Myanmar] than in *C. chitra* (mean number 2), as well as their illustration of *C. indica* having three cusped scales along the lower margin of the forelimb, agrees with that outlined below. *Chitra* has but one completely smooth scale along the upper margin of the forelimb (not two*,* their Fig. 4). The antebrachial scalation does not include somewhat illusionary thickenings within the membranous part of the limb created by the bones of the non-clawed 4th and 5th digits; William P. McCord (in litt.) acknowledged that the distalmost second such smooth scale ("pseudodigit") along the upper margin of the forelimb in their Fig. 4 was an artistic error (corresponding "extra" scale also depicted in Loveridge and Williams, 1957;419, Fig. 51A, for *Trionyx triunguis*). McCord and Pritchard's ("2002"2003) account prompts one of us (RGW) to further discuss this long-monitored "scalation" in trionychid turtles.

The antebrachial scalation (Webb, 1962:464), the total complement of "scales" on the ante-

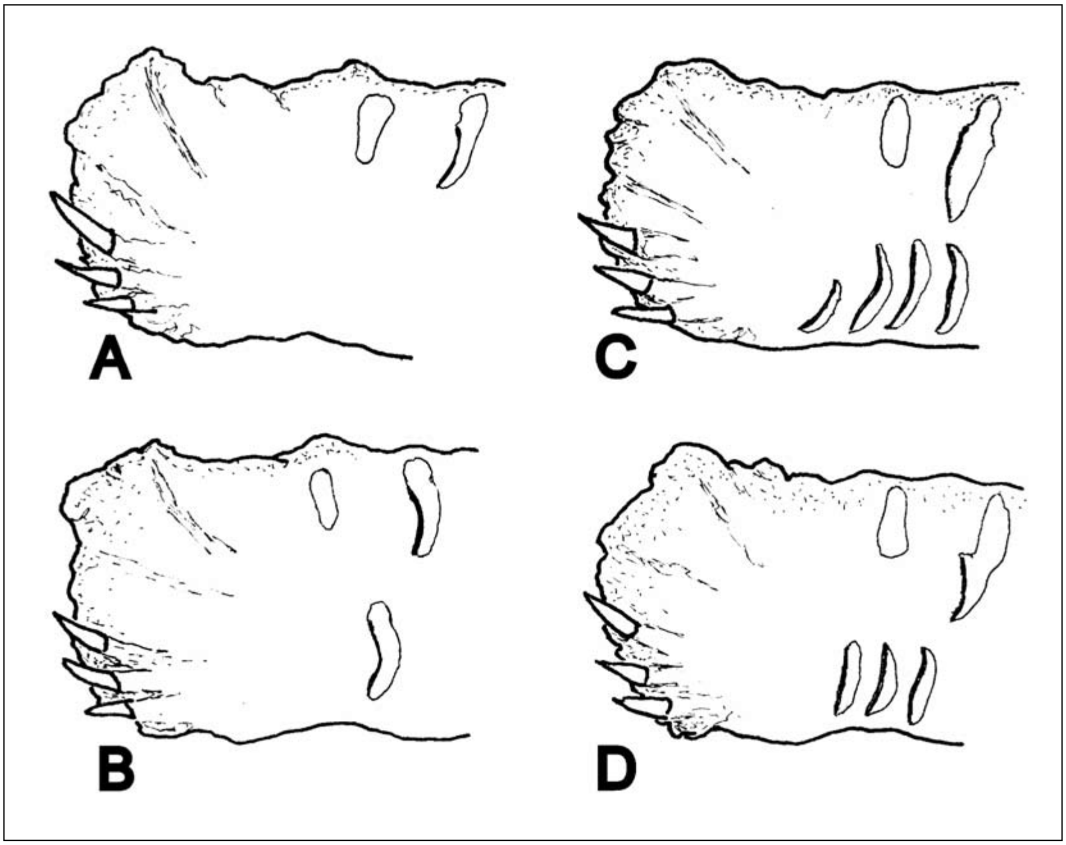

FIGURE 1: Diagrammatic sketches of variation in antebrachial scalation (anterior surface of right forearm, except B, mirror image of left forearm) of *Chitra chitra* (A and B, CUMZ(R) 1991.4.18.1 and 1991.4.18.3, Thailand: Khwae Noi, see text) and *Chitra indica* (C, ZSI 21539, n = 2, India: Maharashtra: Dhond, near Poona; D, SMF 47213, Pakistan: Sindh: Sonda [young, photo in Mertens, 1954:104, Fig. 19]).

rior surface of each forelimb of member species of the Family Trionychidae, segregates into three groups (different kinds and patterns) corresponding to three subfamilies, and supports recognition of the subfamily Chitrinae. Comparative and variational details relative to subfamilies (and antebrachial scalation, below) are reserved for publication elsewhere (Webb, in progress).

All trionychids have at least one, vertically oriented, completely smooth scale along the upper margin of the forelimb. In addition, member taxa of Cyclanorbinae have a distally placed array of small, curved (crescent-shaped), cusp-edged scales (see Loveridge and Williams, 1957:419, Figs. 51B, C, *Cyclanorbis elegans* and *C. senegalensis*, and Gramentz, "1998" 1999:346, Fig. 15, color, *Cycloderma aubryi*), whereas those of Trionychinae have three proximal, vertically oriented, cusp-edged scales (staggered, one above between two below; see Webb, 1962:465, Fig. 14, *Apalone spinifera*); the upper scale may be partly (upper part) smooth.

The antebrachial scalaton in Chitrinae (*Chitra* and *Pelochelys*) is unique in usually having vertical, cusp-edged scales along the lower margin of the forelimb. Unlike the general uniformity in pattern of member taxa of the Trionychinae and Cyclanorbinae, inconsistencies occur between *Chitra* and *Pelochelys* and among species of *Chitra*. All chitrinine taxa have a partly smooth and cusp-edged scale that is proximal to either one (*Chitra*) or two (*Pelochelys*) completely smooth scales along the upper margin of the forelimb (Webb, 1995:307); in *Pelochelys* the proximalmost scale may be almost completely smooth with only a small, lower, cusped edge. The number of vertical, cusp-edged scales along the lower margin of the forelimb varies among species of *Chitra* (usually three or four in *C. indica*; no more than two, usually one or none in *C. chitra*, Fig. 1); these scales (along lower margin) in the three species of *Pelochelys* (Webb, 1995, "2002"2003) are similar in number to that in *Chitra chitra.*

The antebrachial scalation based on three hatchlings of *C. chitra* from Thailand (CUMZ(R) 1991.4.18.1-3) consists of two scales along the upper margin (one completely smooth, the proximal scale somewhat more elongate and smooth but partly cusp-edged). Vertical, cusp-edged scales along the lower margin are absent, except for one cusp-edged scale on the left limb of the largest hatchling. This variation in the *C. chitra* hatchlings is compared with the antebrachial scalation in *C. indica* in Fig. 1.

DISTRIBUTION

Most previous commentary has dealt with occurrence in the Mae Klong drainage in western Thailand. Kitimasak and Thirakhupt (2002) reported occurrence in the Mae Nam Ping (Ping River) in the adjacent Chao Phraya drainage. A long-ignored museum specimen from the Bang Pakong River basin, adjacent eastward to the Chao Phraya basin of central Thailand, attests to a wider range in Thailand. Flower (1899:621-622) erroneously identified this specimen as *Pelochelys cantoris* collected 29 March 1897 "in the Bangpakong river, a little below Kabin" (= Bang Pakong River and Kabin Buri at 13°57'N-101°43'E); he noted color in life and mentioned five pale longitudinal lines on the neck. This juvenile (BMNH 1897.10.8.1, in fluid, examined by PPvD, color photos to RGW) has an obvious umbilical scar with a carapace 48.6 mm long and 38 mm wide and plastron 36 mm long, and is without question referable to *Chitra chitra*.

A final item concerns the identity of some trionychid fossil shell fragments from Sulawesi (investigated by PPvD) most recently reported as "*Chitra ?indica*" (Whitten et al., 1987; second edition, 2002). Hooijer (1954:488, Pl. 1, Figs. 4 & 5) first reported and illustrated two shell fragments (identified as costal and left hypoplastron) as "gen. et spec. indet." The material was collected by Mr. H.P. van Heekeren at Sompoh, in the "Tjebengè" [= Cabenge] area [ca. 115 air km NNE Ujung Pandang], Sopeng District, South Sulawesi, and was initially considered of Pleistocene age (Hooijer, 1954:486). Later Hooijer (1958:90) described the fossils as derived from river-laid sediments (with volcanic components) exposed between the valley of the Walanae River and the Singkang depression, and allowed the possibility that the fossils were reworked from older deposits. The locality was mainly collected for Pleistocene human stone

tools and mammal fossils of the *Archidiskodon-Celebochoerus* fauna (also including various fragments of the giant tortoise *Megalochelys atlas* Falconer & Cautley, 1837). Hooijer (1958) noted this fauna to be entirely different from any Pleistocene fauna elsewhere in the Indo-Australian region and, following work by Bartstra (1978) and Sartono (1979), reconsidered the stone tools as much younger than the *Archidiskodon-Celebochoerus* fauna (including the trionychid fragments) for which a late Pliocene age was accepted (Hooijer, 1982:173). Hooijer (1958:92) noted that the trionychid fragments "...do not permit of a specific determination. One fragment of the plastron suggests *Chitra indica* (Gray)." One of us (PPvD) examined this material at the RMNH and determined it "unlikely *Chitra*, but consistent with *Pelochelys*" (in litt. to RGW, 18 October 1995), and later, after detailed examination, concluded that the sculpturing of the bone fragment surfaces is too fine for *Chitra* but potentially consistent with *Pelochelys*, as the sculpture pits and ridges are very regular and spaced between 2.7 and 4.7 mm apart. Nevertheless, the material is still best considered "Trionychidae, genus and species indeterminate" as Hooijer (1954:488) originally proposed.

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A NEW SPECIES OF *KALOULA* (ANURA: MICROHYLIDAE) FROM NORTH-EASTERN INDIA

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(with four text-figures)

ABSTRACT.– A new species of microhylid of the genus *Kaloula* is described from Assam and Arunachal Pradesh states, north-east India. *Kaloula assamensis* new species, is compared with congeners from south and south-east Asia. The new species is diagnosable in showing the following combination of characters: SVL up to 38.0 mm; tympanum not externally visible; choanae rounded, moderately large, at anterolateral edge of palate, separated by a distance greater than twice their length; postnarial ridges across palate not curving backwards towards inner edge of choanae; finger tips slightly dilated; subarticular tubercles prominent, rounded; webbing on pes to level of distal subarticular tubercles, except on toe IV, where it is to the medial tubercle, reaching tips of all toes as a narrow sheath; toe tips slightly rounded; supernumerary tubercle at base of each digit of manus; tarsus smooth, lacking folds; supratympanic fold extends from posterior edge of eye to above insertion of forelimbs; lateral glandular flank ridge absent; abdomen coarsely granular; pale brown dorsally, with a dark-edged bright yellow vertebral stripe, commencing from tip of snout and terminating near vent, where it becomes less distinct; a dark-edged broad dark brown lateral stripes, commencing from the postocular region, and extending to inguinal region; stratified colouration on posterior face of thighs and flanks; and light pericloacal ring present.

KEYWORDS.– *Kaloula*, new species, *Kaloula assamensis*, Microhylidae, systematics, new species, India.

INTRODUCTION

The genus *Kaloula* (Anura: Microhylidae) is at present known to contain 15 nominal species (Diesmos et al., 2002; Iskandar & Colijn, 2000; Dutta, 1997), its members distributed from Sri Lanka and India, east through southern China and Indo-China, Indo-Malaya and the Philippines (Frost, 1985).

North-eastern India is arguably one of the most poorly surveyed regions of tropical Asia, the herpetofauna of the region virtually unknown. Knowledge of the fauna rests largely on a field guide by Chanda (1994) that enumerates species collected in the last 150 years. More recently, faunal lists, species descriptions, range extensions and accounts on the biology of individual species have appeared (e.g., Bordoloi et al., 2000; Choudhury et al., 2001; Dutta et al., 2000; Ao and Bordoloi, 2000; Ao et al., 2003; Kiyasetuo and Khare, 1986).

We report here a new species of *Kaloula* collected from north-eastern India's Assam and Arunachal Pradesh states, which does not match any of the described species of the genus. The

species is allocated to *Kaloula* for showing the following characters considered diagnostic for the genus (see Parker, 1934: 77; Inger, 1966: 116–117; 121): subarticular tubercles enlarged; and bony ridge along posterior border of each choana. Additional characters that are typical of the genus and frequently used to diagnose *Kaloula* from other genera of microhylids include: tongue oval, free posteriorly; tips of fingers expanded into truncate disks; toes webbed; finger I shorter than finger II; no spine-like dermal projections at heel or elbow; belly lacking brown network on yellow background; snout short; inner metatarsal tubercle shovel-shaped; clavices absent; prevomers undivided; sternum large, cartilaginous; and a small, cartilaginous omosternum.

MATERIAL AND METHODS

The specimens comprising the type series were measured between < 1 – 6 years after collection, with Mitutoyo™ dial vernier callipers (to the nearest 0.1 mm): snout-vent length (SVL, from tip of snout to vent); tibia length (TBL, distance between surface of knee to surface of heel, with both tibia and tarsus flexed); head length (HL, distance between angle of jaws and snout-tip); head width (HW, measured at angle of jaws); head depth (HD, greatest transverse depth of head, taken posterior of the orbital region); eye diameter (ED, horizontal diameter of the eyes); interorbital distance (IO, least distance between upper eyelids; internarial distance (IN, distance between nostrils); eye to snout distance (E-S, distance between anterior-most point of eyes and tip of snout); eye to nostril distance (E-N, distance between anterior-most point of eyes and nostrils); and axilla to groin distance (A-G, distance between posterior edge of forelimb at its insertion to body to anterior edge of hindlimb at its insertion to body). In addition, measurements of digits, taken on the left limbs, from the base to tip. Colour notes on the holotype were taken from colour print film, and compared with colour swatches of F. B. Smith (1975; 1981); photographs of limbs were obtained from the preserved paratype, using a Leica trinocular stereoscope. Radiographic examination was done at 40 Kv (2 mA) for 30 secs.

Comparative materials examined are listed in Appendix I. Sources of additional data on character states and distribution of congeneric species of *Kaloula* include the following works: Alcala & Brown (1998), Berry (1975), Boulenger (1882; 1912), Bourret (1942), Diesmos et al. (2002), Dutta et al. (2000), Fei et al. (1999), Inger (1954; 1966), Inger & Stuebing (1989; 1997), Iskandar (1998), Nieden (1923), Parker (1934), Taylor (1962), and van Kampen (1923). Museum abbreviations, where available (indicated with an asterisk), follow Leviton et al. (1985). These include:

- American Museum of Natural History, New York, U.S.A. (AMNH*)
- The Natural History Museum, London, U.K. (BMNH*)
- California Academy of Sciences, San Francisco, U.S.A. (CAS*)
- Chengdu Institute of Biology, Chengdu, China (CIB*)
- Carnegie Museum of Natural History, Pittsburgh, U.S.A. (CM*)
- Zoological Museum of the Department of Wildlife and National Parks, Kuala Lumpur, Malaysia (DWNP)
- Field Museum of Natural History, Chicago, U.S.A. (FMNH*)
- University of Kansas, Museum of Natural History, Lawrence, Kansas, U.S.A. (KU*)
- Museum of Comparative Zoology, Harvard University, Cambridge, MA, U.S.A. (MCZ*)
- Naturhistorisches Museum Basel, Switzerland (NMBA*)
- Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC; the abbreviation used in Leviton et al., 1985, is USDZ*)
- National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. (USNM*)
- Raffles Museum for Biodiversity Research, National University of Singapore, Singapore (ZRC; the abbreviation in Leviton et al., 1985 is USDZ*)

- Zoological Survey of India, National Zoological Collection, Kolkata (formerly Calcutta), West Bengal, India (ZSI*)
- Zoological Survey of India, Eastern Regional Station, Shillong, Meghalaya, India (ZSI/ERS)

SYSTEMATICS

Kaloula assamensis new species

(Figs. 1–3)

Type series.- ZSI A.10069 (holotype; ex–ID 7103) from Majbat (26º 45'N; 92º 20'E; 141 m ASL), Sonitpur District, Assam state, north-east India, Saibal Sengupta, collector, 7 April 1998, adult male; ZSI/ERS 37314 (paratype), from Nameri Wildlife Sanctuary (26º 56'N; 92º 52'E; ca. 140 m ASL), Sonitpur District, Assam state, north-east India, Saibal Sengupta, collector, 21 February 2003, adult male; Saibal Sengupta collection, to be deposited at ZSI/ERS (paratype), from Sirajuli (26º 41–42'N; 92º 11–12'E; sampling elevation unknown), near Orang National Park, Sonitpur District, Assam state, north-east India, Pankaj Sharma, collector, 8 June 2001, adult female; ZSI/ER 37315 (paratype), from Pakke (Pakhui) Wildlife Sanctuary, Arunachal Pradesh, Kameng District, north-eastern India (26º 55' 25.6"N; 92º 51' 37.2"E; 94 m ASL), Bakhtiar Hussain, collector, 28 May 2004, adult male; ZSI A.9790–91 (two paratypes), Orang National Park (26º 30'N; 92º 15'E; 60 m), Darrang District, Assam state, north-eastern India, M. Firoz Ahmed and Sushil K. Dutta collectors, 15 September 1998, juvenile female and juvenile male, respectively. The type localities are indicated in Fig. 4.

Diagnosis.- A small (SVL up to 38.0 mm) species of *Kaloula*, diagnosable from congeneric species in showing the following combination of characters: tympanum not externally visible; choanae rounded, moderately large, at anterolateral edge of palate, separated by a distance greater than twice their length; postnarial ridges across palate not curving backwards towards inner edge of choanae; finger tips slightly dilated; subarticular tubercles prominent, rounded; webbing on pes to level of distal subarticular tubercles, except on toe IV, where it is to the medial tubercle, reaching tips of all toes as a narrow sheath; toe tips slightly rounded; supernumerary tubercle at base of each digit of manus; tarsus smooth, lacking folds; supratympanic fold extends from posterior edge of eye to above insertion of forelimbs; lateral glandular flank ridge absent; abdomen coarsely granular; pale brown dorsally, with a dark-edged bright yellow vertebral stripe, commencing from tip of snout and terminating near vent, where it becomes less distinct; a dark-edged broad dark brown lateral stripes, commencing from the postocular region, and extending to inguinal region; stratified colouration on posterior face of thighs and flanks; and light pericloacal ring present.

Description of holotype (adult male).- A small species of *Kaloula*, SVL 38.0 mm; habitus rounded, body rather short, with a undifferentiated waist; head proportionately small, broader than long (HW/HL ratio 1.55), indistinct from neck; snout-tip rounded in dorsal aspect, ventrally sloping in lateral aspect, not projecting beyond mandible; nostrils dorso-laterally positioned, nearer tip of snout than to orbit of eye (E-N/E-S ratio 0.78); internarial distance greater than distance from anterior margin of eye to nostril (IN/E-N ratio 1.03); eye large (ED/HL ratio 0.65); its diameter greater than eye to nostril distance (ED/E-N ratio 1.66); interorbital region flat; interorbital width greater than upper eyelid width (IO/UE ratio 2.19); canthus rostralis distinct, concave; loreal region slightly concave; nostrils not protruberant; upperjaw edentate; a weak 'W'- shaped notch (= symphysial knob) on anterior edge of mandible; mouth extends to midorbital level; tongue oval, with papillae, with rounded tip; pupil shape rounded; tympanum not externally visible; supratympanic fold distinct, extending from posterior corner of eyes to supra-axillary region; vomerine teeth absent; choanae rounded, moderately large, at anterolateral edge of palate, separated by a distance greater than twice their length; postnarial ridges across palate not curving backwards towards inner edge of choanae.

Fingers free of web; relative length of fingers: 3 > 2 > 4 > 1; finger tips slightly dilated; subarticular tubercles prominent, rounded, numbering one on first and second fingers, and two on third and fourth fingers; supernumerary tubercle

FIGURE 1: Dorsal view of a paratype of *Kaloula assamensis* new species (ZSI A.9790) in life.

FIGURE 2: Dorsal view of preserved holotype of *Kaloula assamensis* new species (ZSI A.10069).

at base of each digit of manus; toes about half webbed; webbing on outer aspect of toe I, and inner and outer aspects of toes II, III and IV, to wide beyond basal subarticular tubercle, reaching the tip as a narrow sheath; relative length of

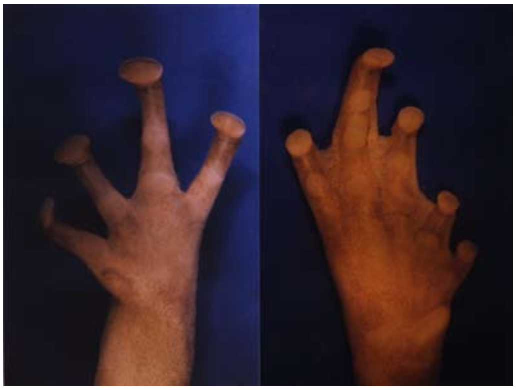

FIGURE 3: Manus and pes of a paratype of *Kaloula assamensis* sp. nov. (ZSI A.10069). Markers = 5 mm.

toes: 4 > 3 > 5 > 2 > 1; toe tips slightly rounded; subarticular tubercles prominent, rounded, numbering one on first and second toes; two on third and fifth toes; and three on fourth toe; a pointed inner and an oval outer metatarsal tubercles, measuring 3.1 and 2.2 mm, respectively; inner metatarsal tubercle smaller than first toe; tarsus smooth, lacking folds; dorsal tubercles widespread; lateral glandular flank ridge absent; ventral epidermal adhesive glands not distinctive.

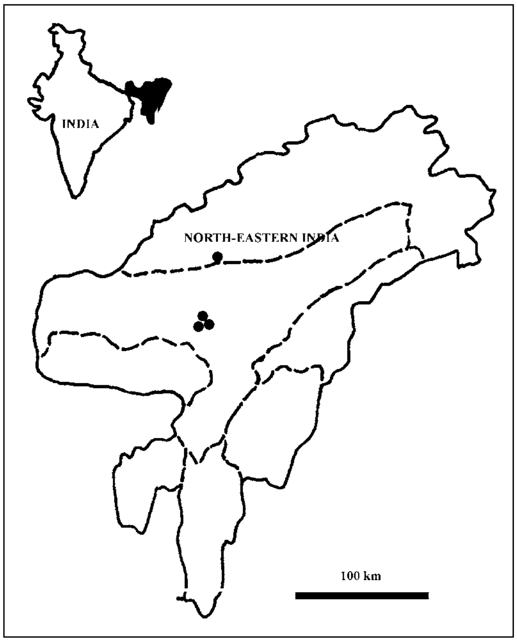

FIGURE 4: Map of north-eastern India, showing the type locality of *Kaloula assamensis* sp. nov. See text for details.

Dorsum granular, especially on midback and also on upper surfaces of limbs; supratympanic fold extends from posterior edge of eye to insertion of forelimbs; abdomen coarsely granular.

Osteological notes.– Procoracoid present; clavicle absent; prevomers undivided; sternum large, cartilaginous; a small, cartilaginous omosternum; and maxillary teeth absent.

Colour.- Holotype in preservative pale brown dorsally, with a dark-edged bright yellow vertebral stripe, commencing from tip of snout and terminating near vent, where it becomes less distinct; dark-edged, broad dark brown lateral stripes, commencing from the postocular region, and extending to inguinal region; upper surfaces of fore and hind limbs pale brown, unbanded; stratified colouration on posterior face of thighs and flanks; venter cream, unpigmented; light pericloacal ring present. Paratypes in life, ground colour of dorsum Vinaceous Pink (# 221C), edged with Vandyke Brown (# 121); postocular band Pale Pinkish Buff (# 121D); and upper surfaces of fore and hind limbs Flesh Color (# 5).

Measurements (in mm, holotype).- SVL 38.0; HL 7.3; HW 11.3; HD 7.4; BW 17.6; TBL 13.7; ED 4.8; UE 3.1; IN 3.0; IO 6.8; E-S 3.7; E-N 2.9; A-G 14.4. Table 1 provides measurements of individual type specimens.

Etymology.- Latin for inhabitant of Assam state, where most specimens from the type series were obtained.

COMPARISONS

The new species from Assam state is compared with its 15 known congeners, listing only opposing suites of characters for congeners:

Kaloula baleata (Müller, 1836) (distribution: Andaman Islands of India, mainland and insular south-east Asia): metacarpal tubercles at base of fingers absent; dorsum grey-brown, with a dark purple blotch; colouration of posterior surface of thighs and flanks not stratified; axillary inguinal regions with red or orange spots; and SVL to 66.0 mm; *K. borealis* Barbour, 1908 (distribution: eastern China and Korea): dorsum grey-brown with scattered dark brown blotches, forming a network on the flanks; and SVL to 54.0 mm; *K. conjuncta* (Peters, 1863), including the subspecies *negrosensis* (distribution: throughout the Philippines, except Palawan and the Sulu Archipelago; *negrosensis* is restricted to Negros, Panay and Cebu, in the Philippines): postnarial ridges curve back mesially towards inner edge of choanae; fingers with greatly expanded disks; dorsum grey-brown with an irregular pattern; flanks darker; and SVL 29–47.0 mm; *K. kalingensis* Taylor, 1922 (distribution: Luzon, Philippines): loreal region vertical; tympanum distinct; tips of fingers greatly dilated; dorsum bluish-black, sometimes with red markings on upper arm; colouration of posterior surface of thighs and flanks not stratified; and SVL to 36.5 mm; *K. kokacii* Ross and Gonzales, 1991 (distribution: Catanduanes, and also southern Luzon, Philippines): supernumerary tubercles absent; tips of fingers greatly dilated; dorsum mottled dark brown; colouration of posterior surface of thighs and flanks not stratified; and SVL to 37–43 mm; *K. manchuriensis* Boring & Liu, 1932 (distribution: eastern China): fingers not dilated, lacking supernumerary tubercles; dorsum brown with scattered darker flecks; and SVL 57.5 mm; *K. macrocephala* Bourret, 1942 (distribution: Vietnam and Thailand; elevated to species sta-

tus by Ohler, 2003, who synonymised under this nominal taxon, *K. aureata* Nutaphand, 1989), indistinct dorsolateral stripes; middorsum yellowish-orange, with irregular dark patches; and SVL 59.9 mm; *K. mediolineata* (Smith, 1917) (distribution: South-western Thailand; new record from Laos by Stuart, 1993): weak supratympanic fold; a large dark blotch on dorsum covering the back; a light spot over forearm and SVL to 63.0 mm; *K. picta* (Duméril & Bibron, 1841) (distribution: the Philippines, except the Sulu Archipelago): postnarial ridges curve back mesially towards inner edge of choanae; snout short; fingers not dilated distally; inner metatarsal tubercle equal to or smaller than toe IV; dermal fold along forearm; lateral glandular flank ridges present; and dorsum brown with a large, irregular blotch; *K. pulchra* Gray, 1831 (distribution: north-eastern India, east to eastern China and south to Indo-Malaya): toes weakly dilated and basally webbed; a weak tympanic fold; snout subequal to eye diameter; and SVL to 75.0 mm; *K. rigida* Taylor, 1922 (distribution: northern Luzon): postnarial ridges curve back mesially towards inner edge of choanae; fingers not dilated distally; lateral glandular flank ridges present; and large size, SVL 34–47.0 mm; *K. rugifera* Stejneger, 1924 (distribution: south-eastern China): dorsum olive brown, with yellowish-olive chin and throat, and a scapular mark from the axillary region of the same colour; *K. taprobanica* Parker, 1934 (distribution: northern and peninsular India and Sri Lanka): toes weakly dilated; a weak tympanic fold; and SVL to 56.0 mm; *K. verrucosa* Boulenger, 1904 (distribution: south-eastern China): postnarial ridges curve back mesially towards inner edge of choanae; dorsum brownish-grey, unpatterned or with rows of indistinct spots; and SVL to 61.0 mm; and *K. walteri* Diesmos, Brown & Alcala, 2002 (distribution: Luzon and Polillo, Philippines): smaller body size, SVL of the type series 24.5–31.5 mm; reduced outer metatarsal tubercles; and dorsal tubercles present or absent.

NATURAL HISTORY NOTES

The holotype of the new species was unearthed in a field of mustard (*Brassica juncea*). The Nameri paratype was found sitting on an herbaceous plant, ca. 0.3 m above substrate, at 1830 h, within an evergreen forest. Other amphibian species found in sympatry with the new species at this site include *Megophrys parva, Rana humeralis, R. leptoglossa, Fejervarya* aff. *limno-*

TABLE 1: Measurements (in mm) of the type series of *Kaloula assamensis* sp. nov. See text for abbreviations.

	ZSI A.10069 (holotype)	ZSI/ERS 37314 (paratype)	Saibal Sengupta coll (to be deposited in ZSI/ERS) (paratype)	ZSI A.9790 (paratype)	ZSI A.9791 (paratype)	ZSI/ERS 37315 (paratype)
sex	adult female	adult male	adult female	juvenile male	juvenile female	adult male
locality	Majbat, Assam	Nameri Wildlife Sanctuary, Assam	Sirajuli, Assam	Orang National Park, Assam	Orang National Park, Assam	Pakhui National Park, Arunachal Pradesh
SVL	38.0	43.1	37.9	30.0	29.4	42.0
HL	7.3	9.8	8.7	7.6	7.0	9.5
HW	11.3	14.7	12.1	9.7	9.0	14.7
HD	7.4	13.1	12.2	6.4	4.8	5.0
TBL	13.7	12.9	10.9	11.0	9.4	14.7
ED	4.8	4.2	3.6	3.1	2.7	4.8
UE	3.1	3.2	2.5	2.3	2.4	3.3
IN	3.0	2.9	2.7	3.4	2.6	3.0
IO	6.8	4.4	5.5	3.3	3.0	4.0
E-S	3.7	5.40	3.9	3.4	3.4	5.4
E-N	2.9	3.1	3.1	2.0	2.0	3.2
A-G	14.4	20.4	15.5	13.0	11.0	18.3

charis, Microhyla ornata and *Uperodon globulosum*. The Sirajuli paratype was found under herbaceous moist vegetation. The eggs, larvae stages and call of the new species remain unknown. The two Orang paratypes were collected during the post-monsoon season, while sitting on blades of the grass *Saccharum* spp., ca. 1 m above ground. Seven other species of anurans (including the type series of *Kalophrynus orangensis* Dutta et al., 2000) were found at this locality. The Pakhui paratype was collected from a fern within a waterlogged area, while sitting at a height of ca. 0.6 m above substrate, at 1920 h. In sympatry were *Chirixalus simus, C. vittatus, Polypedates leucomystax* and *Rana humeralis.*

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APPENDIX I

List of comparative material examined

Kaloula baleata (Müller, 1836): FMNH 128662, Bali, Indonesia; FMNH 128656, Lombok, Indonesia; FMNH 121542, "North Borneo" (= Sabah, East Malaysia); ZSI uncatalogued, Mount Harriet National Park, South Andamans Island, India; DWNP A.0975, forest trail along Sungai Relau, Merapoh, Taman Negara, Pahang State, Peninsular Malaysia.

Kaloula borealis Barbour, 1908: CAS 32520, Chiksan, Kwi-Do Province, South Korea; CIB 55017, 55171, 55156, 620489, China; FMNH 24716, Hopei (= Hopeh), China.

Kaloula conjuncta (Peters, 1863): FMNH 40484, Negros Oriental Province, Philippines; CAS 62445–47, Burdeos, Polillo, Philippines.

Kaloula kalingensis Taylor, 1922: FMNH 125649, Luzon, Philippines; CAS 144374–75, vicinity of Beijing, China; FMNH 259517, Kalinga Province, Luzon, Philippines.

Kaloula kokacii Ross and Gonzales, 1991: FMNH 248007, Catanduanes Island, Catanduanes Province, Philippines; FMNH 142560, Camarines Sur Province, Luzon, Philippines.

Kaloula mediolineata (Smith, 1917): FMNH 143160, Thailand; MCZ A–8761, Nakhon Ratchasima, Thailand.

Kaloula picta (Duméril & Bibron, 1841): CAS 61057–60, Los Baños, Laguna Province, Luzon, Philippines; FMNH 51511, Palawan Province, Philippines.

Kaloula pulchra Gray, 1831: FMNH 207664, "North Borneo" (= Sabah, East Malaysia); FMNH 75541, Kalimantan Barat, Borneo (Indonesia); FMNH 256945, Lantau, Hong Kong, China; FMNH 215300, Singapore; KU 186845, north of Tinsukia, Assam, India; MCZ A–117052–53, Hong Kong, China; ZSI uncatalogued, Mizoram, India.

Kaloula rigida Taylor, 1922: FMNH 125613, FMNH 125614, Luzon, Philippines.

Kaloula rugifera Stejneger, 1924: FMNH 19151, FMNH 18995, Sichuan, China.

Kaloula taprobanica Parker, 1934: AMNH 62917, Mysore, Karnataka, India; AMNH 74277-78, MCZ 1338, Chilaw, North Western Province, Sri Lanka; CM 25322-23, Kanchrapara, ca. 25 km n. Kolkata, West Bengal, India; CM 67954. Deniyaya- Sinharaja Camp Forest Reserve, Southern Province, Sri Lanka; FMNH 81239, FMNH 122625, "Ceylon" (= Sri Lanka); MCZ 23019. "South India"; MCZ 452. Ambala, Punjab, India; MCZ 1338; NMBA 4413, "Sri Lanka"; NMBA 1423-24, Warakapola, Sri Lanka; ZSI uncatalogued, Vadanemmeli, south India.

Kaloula verrucosa Boulenger, 1904: FMNH 50980, Sikang, China; FMNH 3654, MCZ A–8836–38, Yunnan, China.

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ON THE OCCURRENCE OF THE WATERSNAKE *SINONATRIX AEQUIFASCIATA* (BARBOUR, 1908) (SERPENTES, COLUBRIDAE, NATRICINAE) IN VIETNAM

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ABSTRACT.– The collection of an adult specimen of the natricine water snake *Sinonatrix aequifasciata* (Barbour, 1908) near Tam Dáo, northern Vietnam, confirms the occurrence of this species in Vietnam; this species was previously known only from south-eastern China. The specimen is described and compared with Chinese specimens of *Sinonatrix aequifasciata* and with *Sinonatrix yunnanensis* Rao and Yang, 1998, a species recently described from Yunnan. An artificial key to the genus *Sinonatrix* is provided.

KEY WORDS.– Serpentes, Colubridae, Natricinae, *Sinonatrix aequifasciata, Sinonatrix yunnanensis*, China, Vietnam, Tam Dáo.

INTRODUCTION

The genus *Sinonatrix* Rossman and Eberle, 1977 (type species *Tropidonotus annularis* Hallowell, 1856, by original designation), as presently conceived (Malnate and Underwood, 1988; Rao and Yang, 1998), includes four species: *Sinonatrix annularis* (Hallowell, 1856), *Sinonatrix aequifasciata* (Barbour, 1908), both mostly found in China (including Taiwan in the case of *S. annularis*), *Sinonatrix yunnanensis* Rao and Yang, 1998, currently known only from the Chinese province of Yunnan, and *Sinonatrix percarinata* (Boulenger, 1899), ranging from north-eastern India through northern Myanmar to eastern China, to Vietnam and northern Thailand. These relatively large (up to 1.4 m for *S. aequifasciata*) snakes are primarily semiaquatic.

During a trip to Vietnam in 1998 in the region of Tam Dáo Hill Station, Province of Vinh Phú, two of the authors (NB and GV) obtained a specimen of *Sinonatrix aequifasciata*, which proved at that time to be the first one recorded in Vietnam. This species, originally described as *Natrix aequifasciata* (Barbour, 1908: 317. Type locality: "Mt. Wuchi", now Mt. Wuzhi, Hainan Island, People's Republic of China), has a large range in southern China, being known from the provinces of Fujian, Guizhou, Guangdong, Hong Kong, Guangxi Huang Autonomous Region, Hainan Island, Hunan, Jiangxi, Sichuan and Zhejiang (Zhao et al., 1999). Specimens from Yunnan (Jingdong, Menglian, Yongde) were referred to *Sinonatrix yunnanensis* by Rao and Yang (1998) on the basis of differences in dentition and scalation.

For some reason, the publication of the discovery of this species in Vietnam was delayed. Subsequently, *Sinonatrix aequifasciata* was first cited from Vietnam by Orlov et al. (2000), also from Tam Dáo Hill Station, but without further information on the collected specimen(s) or description. This species was no longer mentioned again in the Vietnamese fauna, including in a paper on rare snakes of Vietnam by Orlov et al. (2003). In the present note, our Vietnamese specimen is described and compared with

Chinese specimens of *Sinonatrix aequifasciata* and *Sinonatrix yunnanensis.* A key to the four known species of the genus is provided.

MATERIAL AND METHODS

Specimens used for comparison are listed in the Appendix. Measurements, except body and tail lengths, were taken with a slide-caliper to the nearest 0.1 mm; measurements on body (all in millimetres) were measured to the nearest millimetre. Ventral scales were counted according to Dowling (1951). The terminal scute is excluded from the number of subcaudals. The number of dorsal scale rows is given at one head length behind head, at midbody (i.e., at the level of the ventral plate corresponding to half of the total number of ventrals), and at one head length before vent, respectively. Values for symmetric head characters are given in left/right order.

Museum abbreviation. MNHN: Muséum National d'Histoire Naturelle, Paris, France.

RESULTS

Specimen MNHN 1998.0549, adult male, collected by native people in early June 1997 in the vicinity of the Tam Dáo Hill Station (Tram Tam Đáo), north of the city of Tam Dáo, Vinh Phú Province, Vietnam.

This animal was found in a forested area, but the exact elevation and biotope were unfortunately not recorded. The Tam Dáo Hill Station is located near the south-western extremity of the Tam Dáo mountain ridge, a narrow range extending on 80 km, with a maximal width of 10 km. The maximum elevation of the ridge is 1,591 m asl, the Tam Dáo Hill Station being perched at 930 m asl. This ridge, largely karstic in topography, is heavily forested with mountain tropical and subtropical monsoon broad-leaved and bamboo forests (see Orlov, 1997, for a description), although uncontrolled logging has severely damaged large areas close to its human settlements.

Description.- Body stout, cylindrical; head oval, strongly elongate, rather narrow, barely distinct from neck; snout long, accounting for 29.2 % of total head length, 2.0 as long as horizontal diameter of eye, slightly flattened, narrowing at its tip which is nearly blunt when seen from above, rounded seen from side, with no defined canthus rostralis; nostril dorsolateral, directed upwards; eye large, its diameter much greater than distance between its inferior margin and upper lip edge; pupil rounded; tail long, cylindrical and clearly progressively tapering.

Maxillary teeth 23, gradually enlarged posteriorly.

Snout-vent length 485 mm; tail length 152 mm; total length 637 mm.

Ventrals (3 preventrals) + 149 ; subcaudals 78, all paired; anal divided.

Dorsal scale rows 19-19-17, strongly keeled except those in outermost row which are smooth.

Dorsal scale rows reduction:

left: 3rd + 4th → 3rd (ventral 89)

right: 3rd + 4th → 3rd (ventral 90)

Rostral twice as wide as high; internasals subtriangular, longer than wide, distinctly anteriorly narrowed; prefrontals only slightly larger than internasals, reaching loreal; one large, undivided supraocular on each side; nasal rectangular, much longer than high, divided into two parts, with a dorsolateral nostril piercing upwards near upper edge of the limit between nostril parts; one subrectangular, gothic-shaped loreal; 9/9 supralabials, 5th entering orbit, 4th and 6th separated from orbit by only a small scale, 7th largest; 1/1 preocular; no subocular; 3/3 postoculars; 2 + 2 + 3 temporals on both sides; 10/9 infralabials.

In life and preservative, dorsal and upper tail surfaces are dark grey, marked on each side of body with 21 and on each side of tail with 13 wide, regular, distinct vertical black bands encircling body, which are strongly constricted in their middle at mid-height of flanks; wider lower and upper parts of each band marked with an oval blotch of dorsum ground colour, giving the appearance of conspicuous, broad rounded X-shaped markings on each flank, the X more or less contacting each other by their upper branches on the vertebral line; bands immediately behind head and towards the tail end indistinct. Head uniformly dark olive grey, without any marking. Venter dirty whitish yellow, darker towards tail, marked with irregular double (sometimes single) black bands coming from lateral

X-shaped markings, separated by a more or less wide amount of venter ground colour.

DISCUSSION

Sinonatrix aequifasciata has been adequately described in the literature. We give below a comparison between major meristic characters of the Chinese specimens and values or state of our Vietnamese specimen, which are given in square brackets. The data of Chinese specimens are drawn from Pope (1935), Hu et al. (1980), Wu et al. (1985), Huang and Jin (1990), Rao and Yang (1998) and Zhao et al. (1998).

Ventrals 140-154 [149]; subcaudals 62-78 [78]; anal plate divided [divided]; dorsal scale rows 19-19-17, strongly keeled [idem]; supralabials 9-10 (rarely 8) [9/9]; supralabials entering orbit: 4th-5th or 5th (rarely 5th-6th, or 6th) [5th/5th]; preoculars 1 (rarely 2) [1/1]; postoculars 3 (rarely 2 or 4) [3/3]; anterior temporals 2 (rarely 1 or 3) [2/2], posterior temporals 3 (rarely 2 or 4) [2]; infralabials 10 (rarely 9 or 11) [10/9]; colour of dorsum dark grey, olive grey or olive brown [dark grey]; presence of diagnostic X-shaped lateral markings [idem].

Our specimen from Tam Dáo agrees with the morphological and meristical characters reported for Chinese specimens of *Sinonatrix aequifasciata*, and does not show significant differences. We also compared our specimen with the description of *Sinonatrix yunnanensis* Rao and Yang, 1998. This species is endemic to Yunnan Province, China. On the basis of the original description, the numbers of maxillary teeth (23) and ventral plates (149) of the Vietnamese specimen differ distinctly from the diagnostic characters given by Rao and Yang (1998) for *Sinonatrix yunnanensis* (31-35 maxillary teeth and 156-165 ventrals, respectively).

The four known species of the genus *Sinonatrix* may be separated by the following key:

1. Over 30 vertical or Y-shaped black bars on sides of body 2

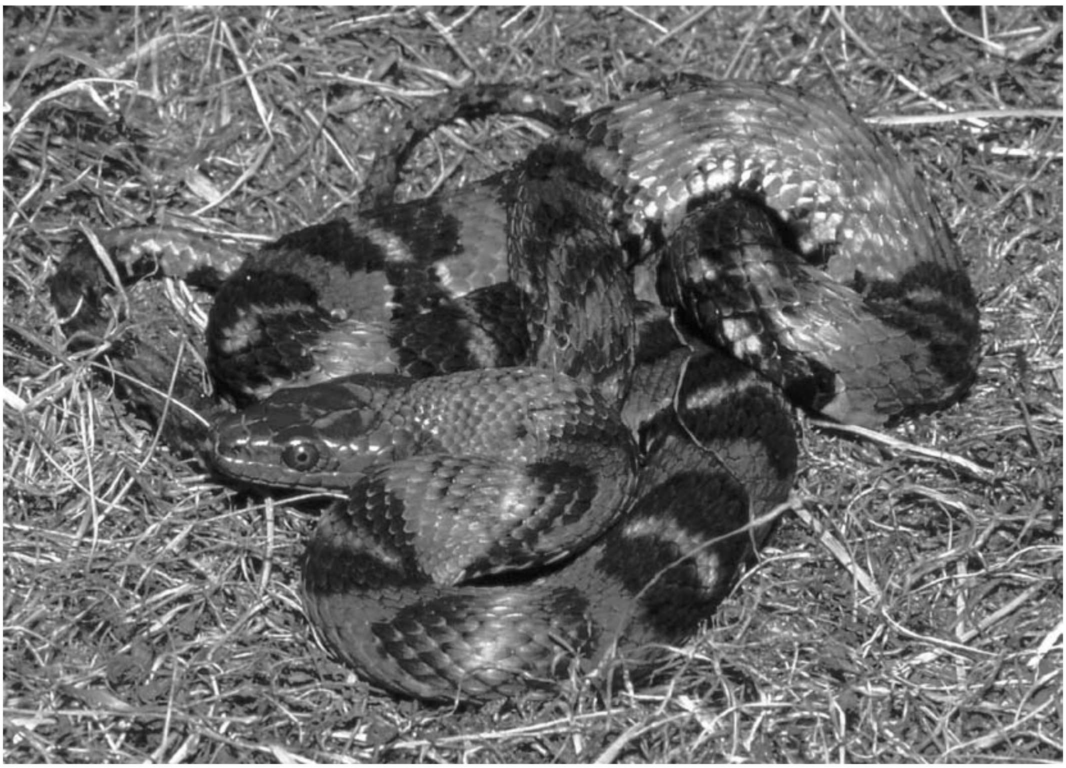

FIGURE 1: *Sinonatrix aequifasciata* (MNHN 1998.0549), general view in life. Photograph by N. Brachtel.

Under 30 broad, rounded X-shaped dark marks on sides of body 3

2. Supralabials with black sutures; belly marked with red; usually one supralabial entering orbit . . . . *Sinonatrix annularis*
   Supralabials without black sutures; belly not marked with red; usually two supralabials entering orbit . . *Sinonatrix percarinata*
3. 142-154 ventral scales, 23-28 maxillary teeth . . . . *Sinonatrix aequifasciata*
   156-165 ventral scales, 31-35 maxillary teeth . . . . *Sinonatrix yunnanensis*

Bourret (1935, 1936) did not describe any specimen referrable to *Sinonatrix aequifasciata*, and this species was not listed from Vietnam by Nguyên and Hô (1996). In China, *S. aequifasciata* is known from the province of Guangxi Zhuang Autonomous Region, which has a common border with Vietnam. According to Lu and Wen (1988), the species inhabits the whole of Guangxi, excepted the area around Nanning. As the Tam Dáo Hill Station is about 120 airline km from the Vietnam - Guangxi Zhuang border, the Vietnamese specimen represents a significant range extension for the species.

The genus *Sinonatrix* was until now represented in Vietnam only by *S. percarinata*, known from the north and centre of the country southwards up to Gia Lai Province (Nguyên and Hô, 1996; Ziegler, 2002). *Tropidonotus trianguligerus* Boie in Boie, 1827, a typical natricine long placed in the genus *Natrix*, was placed in the genus *Sinonatrix* by Orlov et al. (2000). This species is currently usally referred to as *Xenochrophis trianguligerus* (Boie, 1827) (see Malnate and Underwood, 1988).

Sinonatrix aequifasciata should be searched for in other hilly forested areas of northern Vietnam. David et al. (1998) reported the first Vietnamese specimen of *Amphiesma optatum*, another natricine snake previously also known only from southern China, also from the vicinity of the Tam Dáo Hill Station. Although the Tam Dáo mountain ridge is nearly entirely surrounded by lowlands, there is little discontinuity between hills of southern China and those of northern Vietnam.

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REPTILES OF LOANGO NATIONAL PARK, OGOOUÉ-MARITIME PROVINCE, SOUTH-WESTERN GABON

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(with two text-figures)

ABSTRACT.– We provide a preliminary list of the reptiles occurring in Loango National Park, Ogooué-Maritime Province, south-western Gabon. The list includes 37 species (3 crocodilians, 8 chelonians, 14 lacertilians and 12 ophidians) distributed in 30 genera and 16 families, and is accompanied by our biological observations. Loango's herpetofauna is remarkable for its mixture of forest, bunchgrass prairie, mangrove and marine species, and for the high number of endangered and protected species, notably all three African crocodiles and three locally nesting sea turtles.

KEYWORDS.– Reptiles, biodiversity, Loango National Park, Gamba Complex of Protected Areas, Gabon.

INTRODUCTION

Loango National Park (1550 sq. km, LNP) was recently officially established by H. E. President Bongo Ondimba as part of the Complexe d'Aires Protégées de Gamba, and was also classified as a Ramsar site (no. 352). It falls in both Etimboué and Ndougou Departments of Ogooué-Maritime Province in southwestern Gabon, and includes the former Réserve de Petit-Loango and parts of the Domaine de chasse d'Iguéla and Domaine de chasse de Ngové-Ndogo (Anonymous, nd). It is renowned for high densities of large mammals, including lowland gorilla, chimpanzee, elephant, hippopotamus and buffalo. However, although sea turtles have received special attention (Dijkstra, 1993; Fretey and Girardin, 1988; Fretey, 2001; Pauwels, 2004), the remaining herpetofauna of LNP has never been specifically studied. The park is composed of a mosaic of coastal vegetation types on white sand, including forest, scrub and grassland. This environment, which is common along the coast, has never been herpetologically studied in Gabon.

The Smithsonian Institution, in collaboration with the Shell Foundation and Shell Gabon, has initiated studies (the Smithsonian Institution Monitoring and Assessment of Biodiversity, [SI/MAB] Program) to inventory and conserve the biodiversity of the Gamba Complex of Protected Areas. As part of the SI/MAB Program we undertook a seven week survey of the herpetofauna of a part of LNP, corresponding to the former Réserve de Petit-Loango north of the village of Setté Cama.

MATERIALS AND METHODS

The survey took place from 24 September to 11 November 2002, i.e., at the transition between the dry and wet seasons. Our base camp was established in bunchgrass prairie at 02° 20' 27"S, 09° 35' 33"E, a few hundred meters from the beach and approximately 11km from the mouth of the Ndogo lagoon. Sampling activities were undertaken mainly around the camp area and up to 7km inland.

Specimens were mainly located opportunistically, during visual surveys of all habitats by up to four people. Surveys were undertaken during the day and during the evening. Search techniques included visual scanning of terrain and refuge examination (e.g., lifting rocks and logs, peeling away bark, scraping through leaf

litter, etc.). To supplement opportunistic collecting, habitats were also sampled using arrays of funnel and pitfall traps placed along drift fences. Trap lines were set in different microhabitat types. Drift fences consisted of lengths of black plastic sheeting 30 cm high and stapled vertically onto wooden stakes. An apron left at the base was covered with soil and leaf litter to direct specimens intercepted during their normal movements along the fence towards the traps.

Pitfall traps comprised plastic buckets (275 mm deep, 285 mm top internal diameter, 220 mm bottom internal diameter) sunk with their rims flush to ground level and positioned so that a drift fence ran centrally across the mouth of each trap. One pitfall trap was set at each end of a drift fence with the remaining traps spaced between at regular 8 m intervals. Holes in the base of the buckets allowed water drainage. A few leaves provided shelter for small species. Cylindrical funnel traps were made from fine, steel wire mosquito mesh, shaped by hand and with stapled seams. Measurements were roughly 60 x 25 cm, with funnel entrances narrowing to approximately 30 mm diameter. Traps had funnel openings at one or both ends. The flexible mosquito mesh allowed the funnel entrance to be distorted to a quarter round profile so that the sides fitted flush with the ground and with the drift fence wall. Traps were covered with light vegetation to hide them and to provide cover for captured specimens. They were checked every morning and during the day if a survey team was working in the region. Captive specimens were removed by simply opening a stapled seam, after which it was re-stapled shut. Specimens not retained as voucher specimens were released in the vicinity of capture, but 10m from the trap line. The lengths and orientation of trap arrays were tailored to local conditions, and were set for variable periods (see below). A trap-day is defined as one trap in use for a 24-hour period. Trapping locations included:

- PT1 (02° 20' 25"S, 09° 35' 40"E), 26 Sept. to 25 Oct. In dry inland forest, seven meters in from, and running parallel to, the ecotone with bunchgrass prairie. The latter is dominated by the grass *Rhynchelytrum filifolium* (Poaceae), with ca. 50% cover of vegetation, 50% bare sand.
- PT2 (02° 20' 24"S, 09° 35' 43"E), 26 Sept. to 25 Oct. About 60 m from the ecotone with bunchgrass prairie, in open, wet inland forest dominated by *Sacoglottis gabonensis* trees (Humiriaceae) and with an understorey dominated by *Diospyros* (Ebenaceae), and with few lianas.
- PT3 (02° 20' 27"S, 09° 35' 50"E), 26 Sept. to 25 Oct. Same forest type as for PT2, slightly wetter, with one extremity of the trap ending in a stream bed (dry before the beginning of the rainy season, later inundated).
- FT1 (02° 20' 24"S, 09° 35' 47"E), 26 Sept. to 25 Oct. Beside large fallen log in swamp forest.
- FT2 (02° 20' 24"S, 09° 35' 42"E), 26 Sept. to 25 Oct. In swamp forest, partly encircling the buttresses of a large tree (*Sacoglottis gabonensis*).
- FT3 (as for PT3), 26 Sept. to 25 Oct. Running along stream bed.
- FT/PT4 (02° 20' 40"S, 09° 35' 27"E), 6 to 27 Oct. 6 funnels + 2 buckets (buckets installed on 10 Oct.). Close to the beach, in forest dominated by tall (25 m) *Manilkara lacera* (Sapotaceae) and *Hyphaene guineensis* palm trees (Arecaceae); understorey dominated by *Syzygium guineense* trees (Myrtaceae).
- FT/PT5 (02° 20' 40"S, 09° 35' 27"E), 6 to 27 Oct. 6 funnels + 2 buckets (buckets installed on 10 Oct.). Same habitat as FT/PT4.
- FT6 (02° 20' 39"S, 09° 35' 28"E), 6 to 27 Oct. Beside a pond in a forest patch between bunchgrass prairie and mangrove.
- FT/PT7 (02° 20' 39"S, 09° 35' 27"E), 6 to 27 Oct. 2 funnels + 1 bucket. Near FT/PT5, partly encircling a small pond.
- PT8 (02° 21' 56"S, 09° 36' 26"E), 26 Oct. to 2 Nov. In swamp forest near mangrove.
- PT9 (02° 21' 52"S, 09° 36' 28"E), 26 Oct. to 2 Nov. In forest with numerous *Ceiba pentandra* (Bombacaceae).

- PT10 (02° 21' 45"S, 09° 36' 28"E), 26 Oct. to 2 Nov. Close to PT9 with same habitat; partly encircling a tall *Ceiba pentandra*.
- FT11 (02° 20' 36"S, 09° 35' 36"E), 30 Oct. to 10 Nov. Forest patch in bunchgrass prairie, partly inundated following the first rains of the rainy season.
- FT12 (02° 20' 36"S, 09° 35' 37"E), 30 Oct. to 10 Nov. Same habitat as FT11.
- FT13 (02° 20' 36"S, 09° 35' 38"E), 30 Oct. to 10 Nov. Same habitat as FT11.
- PT14 (02° 20' 35"S, 09° 38' 10"E), 3 to 10 Nov. 2002. In swamp forest.
- PT15 (02° 20' 37"S, 09° 38' 11"E), 3 to 10 Nov. In swamp forest near a temporary pond.
- PT16 (02° 20' 39"S, 09° 38' 12"E), 3 to 10 Nov. Close to PT15, and along the same temporary pond.

Some voucher specimens were collected, anesthetized and injected with formalin (5%) then preserved in 70° ethanol. They are housed in the herpetological collections of the following institutions: Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (IRSNB); Port Elizabeth Museum, Humewood, South Africa (PEM); United States National Museum, Washington D.C., U.S.A (USNM); and the Smithsonian Institution Biodiversity Center, Vembo, Gamba, Gabon (GAM). Scale counts (after Dowling's [1951] method for ventrals; terminal tail scute not included among subcaudals) and measurements were collected from all squamate vouchers and are available from the authors (OSGP).

SPECIES ACCOUNTS

Chelonii

Cheloniidae:

Chelonia mydas (Linnaeus, 1758). Voucher specimen: PEM R5452 (skull), 02° 20' 25"S, 09° 35' 14"E. An adult green sea turtle (curve carapace length 895mm) was found dead on the beach about one km S of camp on 12 Oct. The next morning, the body was found about 100m inland where it had been carried by a leopard (Felidae: *Panthera pardus*) whose tracks were clearly visible all along the way between the two locations. A nest was located on the beach opposite camp during the night of 12 to 13 Oct. The next night tracks of marsh mongoose (Herpestidae: *Atilax paludinosus*) and blotched genet (Viverridae: *Genetta tigrina*) were present around the nest but no eggs were eaten. The species was regularly seen in the sea from the beach in Oct.-Nov. and seems locally common.

Lepidochelys olivacea (Eschscholtz, 1829). No voucher specimens. On 22 Oct. at 22h00 an adult female was photographed (see Ward et al., 2003: 89, 296) as it began to dig its nest. The nest was about 50m behind the high tide line in sand with patchy grass.

Dermochelyidae:

Dermochelys coriacea (Vandelli, 1761). No voucher specimen. On 27 Sept. two females nested on the beach in front of the camp. Both nests were completely washed away by a very high tide on 7 to 8 Oct. Other nests were recorded on 28 Oct., 30 Oct. (4 nests), 1 Nov. (this nest was associated with three fake nest holes while all others we observed had only one fake nest hole; some eggs were dug out by *Ocypode* crabs – crab voucher at IRSNB, I.G. 29926), 2 Nov., 6 Nov. (2 nests; one of these females illustrated by Ward et al. 2003: 69), and 8 Nov. Dijkstra (1993) recorded leatherback turtle nesting at Petit Loango.

Pelomedusidae:

Pelusios castaneus (Schweigger, 1812). Voucher specimen: PEM R5967: 1.4 km N of camp, 800m inland, 1 Nov. Found freshly dead on its back in bunchgrass prairie (see Ward et al., 2003: 133); it had probably died from overheating. Two adult females were found on 28 Oct. in a temporary pool in bunchgrass prairie (02° 20' 17"S, 09° 35' 27"E) following heavy rain (90mm) the previous afternoon. Maran (2002) recorded the presence of this species in LNP.

Pelusios niger (Duméril & Bibron, 1835). No voucher specimens were obtained during our survey, but Maran (2002: 61) recorded the presence of this species in LNP.

Testudinidae:

Kinixys erosa (Schweigger, 1814). Voucher specimens: PEM R5966: PT15, 9 Nov. The spe-

cies was abundant in the survey area, and was observed foraging in leaf litter, or sheltering under dead logs or in hollow trees in dense and open forest. Several adult specimens fell into pitfall traps (PT2 and PT3) and were released.

Trionychidae:

Cycloderma aubryi (Duméril, 1856). No voucher specimens were retained, but a healthy adult specimen was found on the beach about 6 km S of camp in early July (M. Lee). It made no attempt to bite when handled and was released.

Trionyx triunguis (Forsskål, 1775) No voucher specimens were retained, but an adult specimen (curved carapace length 67 cm, maximum curved carapace width 52cm) was found at midday (5 Nov.; specimen illustrated by Ward et al., 2003: 166) in a channel linking a lagoon to the sea (02° 19' 13"S, 09° 35' 14"E). It was immobile in shallow (30 cm deep) water and did not attempt to bite when handled.

Crocodylia

Crocodylidae:

Crocodylus cataphractus Cuvier, 1824. No voucher specimens. Dijkstra (1993) recorded the species from "Lagune Sette Cama" (which was distinguished from "Lagune N'Dogo"). The species was reported to be very common in the Sounga area and is called *ngandou doussomb* (plural: *ngandou tsidoussomb*) by the Loumbou villagers in Setté Cama area (Mackayah, pers. comm., Nov. 2002).

Crocodylus niloticus Laurenti, 1768. No voucher specimens were retained, but specimens were common in the larger coastal lagoons. A large (2.5 m) specimen was basking on a sand strip between a lagoon mouth and the sea (12 Oct., 02° 16' 43"S, 09° 35' 13"E); 19 Oct., a slightly smaller specimen was walking on the bank of the same lagoon; 21 Oct., a young subadult active in a lagoon just behind the beach, 6 km N of camp; 22 Oct, 2230 h, the same specimen (illustrated by Ward et al., 2003:82-83) was found in the sea 60m N of the lagoon which had just broken through into the sea; 25 Oct., a subadult (SVL 98 cm, tail L 106 cm) was found dead in a channel linking a lagoon to the ocean (02° 19' 39"S, 09° 35' 14"E) which had broken through following heavy rains three days before (the crocodile may have been injured by massive logs which were abundant around its dead body, as has been reported for *Dermochelys coriacea,* Fretey, 2001); 4 Nov, 2100-2130 h, several specimens were active on the beach and escaped by running into the ocean, including a 2.5 m specimen (02° 19' 24"S, 09° 35' 11"E), a 1.5 m (total L) subadult (02° 18' 05"S, 09° 35' 11"E) and another of the same size 400 m N. Four juveniles were present in a lagoon connected to the sea (02° 16' 25"S, 09° 35' 14"E). All the above specimens were identified as Nile crocodiles by their characteristic snout shape. This species is called *ngandou koussi* (plural: *ngandou tsikoussi*) by the Loumbou villagers in Setté Cama area (Mackayah, pers. comm., Nov. 2002).

Osteolaemus tetraspis Cope, 1861. No voucher specimens were retained, but after the onset of the rainy season this species was extremely common in pools and swamps in the forest. This species is called *imbaghala* (plural: *bimbaghala*) by the Loumbou villagers in Setté Cama area (Mackayah, pers. comm., Nov. 2002).

Lacertilia

Agamidae:

Agama agama (Linnaeus, 1758). Voucher specimens: PEM R5431 (02° 20' 57"S, 09° 35' 35"E), 29 Sept; USNM 561457, on beach 1 km S of camp, 28 Oct; GAM 049 (02° 21' 54"S, 09° 36' 17"E), 29 Oct; USNM 561458 (02° 20' 23"S, 09° 35' 14"E), 28 Oct. The species was not abundant, and it was restricted to the beach and adjacent dry forest where it was regularly observed on *Hyphaene guineensis* palms and on dead trees. It occurred in strict syntopy with *Trachylepis affinis* (see below).

Chamaeleonidae:

Chamaeleo dilepis Leach, 1819. Voucher specimen: PEM R5434: camp, 29 Sept. The single specimen was found sleeping at night on a tree branch (Rubiaceae) about 2 m above the ground at the junction of forest and bunchgrass prairie.

Gekkonidae:

Hemidactylus fasciatus Gray, 1842. Voucher specimens: PEM R5420 (02° 20' 42"S, 09° 36' 28"E), 25 Sept; PEM R5433: PT2, 30 Sept.; GAM 055 (02° 20' 28"S, 09° 35' 26"E), 7 Oct.; GAM 056, FT2, 13 Oct.; IRSNB 16895, near PT15, 3 Nov.; USNM 561474, near PT8, 1 Nov.; USNM 561475, near PT16, 5 Nov.; USNM 561476, PT15, 8 Nov. During the day this large gecko was usually found under tree bark or in dead, rotting logs; e.g. PEM R5420, under bark of douka tree (*Tieghemella africana*, Sapotaceae) in open forest with little under-storey; another specimen (not collected) in same region in a dead log of *Diospyros cf iturensis* (Ebenaceae). At night specimens were usually active on large tree trunks, between 1.8 to 2 m above ground.

Hemidactylus mabouia (Moreau de Jonnès, 1818). Voucher specimens: PEM R5426 (02° 20' 43"S, 09° 35' 26"E), 27 Sept.; PEM R5432, GAM 057 (02° 20' 57"S, 09° 35' 35"E), 29 Sept.; USNM 561481, beach opposite camp, 17 Oct.; GAM 058 (02° 20' 58"S, 09° 35' 34"E), 30 Oct. All specimens collected were found in the beach area, either in dead logs on dunes, or under bark on dead trees.

Hemidactylus muriceus Peters, 1870. Voucher specimens: PEM R5436, PEM R5969 (02° 20' 15"S, 09° 35' 54"E), 2 Oct.; PEM R5440 (02° 20' 20"S, 09° 35' 39"E), 3 Oct.; PEM R5445, FT2, 8 Oct.; IRSNB 16662, 2 km S of camp, 1.2 km inland, 16 Oct.; GAM 059, near PT1, 30 Oct.; GAM 060 (02° 20' 42"S, 09° 37' 16"E), 1 Nov.; USNM 561484, near PT16, 5 Nov.; USNM 561485, near camp, 7 Nov.; USNM 561486 (02° 20' 39"S, 09° 38' 11"E), 8 Nov.; USNM 561487, 1 km E of camp, 8 Nov. During the day specimens were found under wood debris on the ground or in leaf litter. One specimen was found in wood debris in a stream bed in syntopy with *Natriciteres fuliginoides*. At night it is active in shrubbery, often on thin branches from ground level up to 1.5 m above ground. Two adult females each contained two eggs; USNM 561484 (SVL 55.5mm), eggs 7.0 x 4.9 mm; USNM 561486 (SVL 50.5 mm), eggs 7.1 x 5.0 mm.

Gerrhosauridae:

Gerrhosaurus nigrolineatus Hallowell, 1857. Voucher specimens: PEM R5437 (02° 20' 27"S, 09° 35' 33"E), 3 Oct.; PEM R5405 (02° 20' 27"S, 09° 35' 33"E), 8 Oct.; PEM R5965, near PT1, 10 Oct.; PEM R5411 (02° 19' 56"S, 09° 35' 32"E), 11 Oct.; USNM 561466-67, near PT1, 11-12 Oct.; USNM 561468, near PT1, 14 Oct.; PEM R5435, FT/PT4 (in funnel), 15 Oct.; GAM 053, GAM 054, IRSNB 16892-93, near FT/PT4, 15 Oct. (GAM 053) & 16 Oct. All specimens were observed active during the day in bunchgrass prairie. The observed and voucher specimens fell into three size categories: juveniles (SVL 46 to 58 mm, umbilical scar obvious), subadults (SVL 69 to 79 mm, umbilical scar faint or undetectable), and adults (SVL >137 mm). An adult was observed to investigate a small tunnel in bunchgrass prairie from which two gray-rumped swallows (*Pseudohirundo griseopyga*; vouchers BKS 5969 & 5974) were later trapped.

Scincidae:

Feylinia grandisquamis Müller 1910. Voucher specimens: PEM R5428-9, PEM R5448, PT3, 29 Sept. and 11 Oct.; PEM R5449, FT/PT4 (in pitfall), 11 Oct.; USNM 561492 (02° 20' 29"S, 09° 35' 56"E), 2 Oct.; IRSNB 16889 (02° 20' 20"S, 09° 35' 39"E), 3 Oct.; USNM 561490, PT3, 6 Oct.; USNM 561493-94, FT/PT4 (in pitfall), 13 & 16 Oct.; IRSNB 16890, near PT10, 28 Oct.; USNM 561491, PT9, 1 Nov.; GAM 051, near PT15, 3 Nov.; GAM 052 (02° 20' 23"S, 09° 35' 13"E), 4 Nov. Widespread in wooded and forested habitats, but not open bunchgrass prairie although one specimen GAM 052 was found in sand under a log on the beach 2 m above high tide level. Another specimen (IRSNB 16890) was caught by day under wood debris between the roots of a *Ceiba pentandra* tree. All females contained eggs in various stages of development: USNM 561492 (SVL 105 mm), two eggs (6 x 4.2 mm); USNM 561494 (SVL 98 mm), two eggs (13 x 4.5mm); IRSNB 16890 (SVL 103 mm), three eggs (11.2 x 5.0 mm); USNM 561493 (SVL 109 mm), two eggs in left ovary; PEM R5429 (SVL 88 mm), two eggs (12 x 5

mm) in left ovary. All males (SVL 78-118 mm) were sexually mature and had swollen testes and sperm-filled seminal vesciles. Some specimens were in a pre-slough blue colouration, which was lost after skin shedding. Confusion with this condition probably accounts for Jackson's (2002) report of an unusual "pale, periwinkle blue" colour variant in *Feylinia currori.*

Lygosoma fernandi (Burton, 1836) Voucher specimens: PEM R5444, FT2, 7 Oct.; USNM 561500, PT15, 4 Nov. A very secretive species, of which only two were caught in traps and none were seen active during the survey.

Panaspis breviceps (Peters, 1873) Voucher specimens: PEM R5446, near FT3, 10 Oct.; PEM R5455, near PT3, 14 Oct.; GAM 069 (02° 20' 39"S, 09° 38' 11"E), 12 Oct.; USNM 561502, PT16, 4 Nov. This skink was only found in swamp forest, where it was active among tree roots and dry stream beds.

Panaspis reichenowii Peters, 1874. Voucher specimens: USNM 561504, 2 km S of camp, 2.7 km inland, 16 Oct.; GAM 070, 1.5 km N of camp, 1.5 km inland, 26 Oct. One specimen was running in sunny weather on a dead branch about a meter above the ground, whilst another was active on the ground and entered a tree hole alongside a dry stream bed.

Trachylepis affinis (Gray, 1838) Voucher specimens: PEM R5425 (02° 20' 43"S, 09° 35' 26"E), 27 Sept.; IRSNB 16898, camp, 18 Oct.; PEM R5450 (02° 21' 37"S, 09° 36' 07"E), 26 Oct.; PEM R5452, beach, 1.5 km S of camp, 28 Oct.; GAM 061-062 (02° 20' 23"S, 09° 35' 14"E), 28 Oct.; USNM 561505 (02° 21' 54"S, 09° 36' 17"E), 1 Nov.; USNM 561506 (02° 20' 24"S, 09° 35' 14"E), 4 Nov.; USNM 561507 (02° 20' 07"S, 09° 35' 25"E), 4 Nov. Relatively common along the coastal belt, particularly in association with dead logs of *Hyphaene guineensis* palm tree and in the mangroves among roots of *Rhizophora racemosa* (Rhizophoraceae). Also in bush clumps in bunchgrass prairie, but absent from closed-canopy forest. We follow Bauer (2003) in referring African skinks previously placed in *Mabuya* to *Trachylepis* Fitzinger, 1843.

Trachylepis albilabris (Hallowell, 1857). Voucher specimens: PEM R5421, PT1, 27 Sept.; PEM R5422-3, PT2, 27 Sept.; PEM R5424, PT2, 28 Sept.; PEM R5427, FT2, 29 Sept.; PEM R5442, PT3, 5 Oct.; PEM R5447, PT1, 10 Oct.; PEM R5456-7, PT2, 14 Oct.; USNM 561510, near PT1, 1st Oct.; GAM 063, FT2, 2 Oct.; GAM 064 (02° 20' 27"S, 09° 35' 33"E), 7 Oct.; GAM 065, camp, 7 Oct.; USNM 561511, PT1, 8 Oct.; USNM 561512, PT2, 8 Oct.; IRSNB 16899, FT/PT5 (in pitfall), 13 Oct.; USNM 561513, FT2, 13 Oct.; IRSNB 16900, PT2, 17 Oct. An adult male was found on 2 Oct. in PT3 and released. Another adult was released from FT6 on 23 Oct., another from PT2 on 24 Oct., another from PT10 on 28 Oct., another from PT9 on 29 Oct., another from PT8 on 2 Nov., two others from FT11 and PT10 on 31 Oct., and another from PT14 on 5 Nov. This skink was the most common reptile in LNP, where it was restricted to closed canopy forest, and is replaced in open areas (mangroves, coastal belt and bunchgrass prairie) by *T. affinis*. It forages on the ground in leaf litter, but usually basks and shelters on dead logs.

Trachylepis polytropis Boulenger, 1903. Voucher specimens: PEM R5443, PT3, 8 Oct.; PEM R5453, near PT1, 14 Oct.; PEM R5454, near PT3, 14 Oct.; USNM 561520, PT15, 7 Nov.; GAM 066, PT14, 7 Nov. This large skink was found only in closed canopy forest, where it was much less abundant than *T. albilabris* and preferred large dead trees. A small specimen on a dead tree was captured in a funnel trap baited with two gryllids.

Varanidae:

Varanus ornatus (Daudin, 1803). Voucher specimen: PEM R5459 (skull), (02° 21' 14"S, 09° 35' 47"E), 8 Oct. Part of the skeleton of an adult found dead inside a hollow tree on the beach. Fresh tracks of adults were frequently found on the beach, often following the high tide line for several hundred meters. An adult male (72 + 107 cm) was found basking in the morning in bunchgrass prairie near PT1. Its tongue was white. A specimen was photographed in

November on the beach about 8 km S of camp while it was eating *Dermochelys* eggs (see Ward et al., 2003: 69).

Serpentes

Colubridae:

Boiga blandingii (Hallowell, 1844). No voucher specimen. On 17 Oct. (22h00) a subadult was filmed (S. Lahm) while active in a tree 1.5 km E of camp.

Dipsadoboa duchesnii (Boulenger, 1901). Voucher specimens: PEM R5458 (02° 20' 36"S, 09° 35' 37"E), 28 Oct.; PEM R5459, USNM 561530-31, IRSNB 16888, near PT16, 5 Nov.; GAM 050 (02° 20' 36"S, 09° 35' 37"E), 6 Nov. All specimens were caught at night, either in forest patches in bunchgrass prairie or on bushes on the banks of temporary ponds where frogs were breeding. An adult female (PEM R5458) had ingested an adult *Hyperolius phantasticus* (Boulenger, 1899) vent first, and also contained 4 immature eggs. The subcaudal count (116) of one female (GAM 050) exceeded the previous maximum (113) for females (Chippaux, 2001).

Hapsidophrys smaragdina (Schlegel, 1837). No voucher specimen. An adult was seen (2 Nov.) at midday basking on a dead tree trunk at the ecotone between a forest patch and bunchgrass prairie (02° 20' 36"S, 09° 35' 37"E).

Mehelya stenophthalmus (Mocquard, 1887). No voucher specimen. A piece of shed skin, found on 25 Sept. (02° 20' 42"S, 09° 36' 28"E) about 2 m above the ground in a large hollow tree, was referable to this species. It had a double-keeled enlarged vertebral row, keeled ventrals, and ?-15-15 dorsal scale rows with a weak mediodorsal double keel, and very weak keels without secondary keels on dorsal rows. The latter character precludes *M. poensis* or *M. capensis* (Meirte, 1992), and the scales of *M. guirali* are "strongly keeled and striated, the striations directed obliquely towards the keels" (Boulenger, 1893). Comparison of the shed skin with *M. stenophthalmus* (IRSNB 13041) showed that body scalation and keels were identical.

Natriciteres fuliginoides (Günther, 1858). Voucher specimens: PEM R5430, near PT3, 29 Sept.; PEM R5438-9, USNM 561554 (02° 20' 20"S, 09° 35' 39"E), 3 Oct.; IRSNB 16903 (02° 20' 42"S, 09° 37' 48"E), 25 Oct.; PEM R5486, GAM 067-068 (2°20'20"S, 9°35'43"E), 9 Oct.; USNM 561553 (2°20'33"S, 9°36'00"E), 10 Oct.; USNM 561555, IRSNB 16896 (02° 20' 24'S, 09° 35' 47"E), 12 Oct. Common in swamp forest and river courses. Snakes were active among leaf litter during the day or found under logs or debris in marshy areas and river beds. One specimen (IRSNB 16903) contained the remains of a *Dimorphognathus africanus* (Anura: Ranidae), while in captivity another ate another small ranid (*Phrynobatrachus auratus*, Figure 1). Two specimens increased the range of scale counts known in the species, with a ventral count of only 115 (PEM R5430; previous minimum 117; Chippaux, 2001) and a subcaudal count of 73 (USNM 561554; previous minimum 74; Chippaux, 2001).

Philothamnus carinatus (Andersson, 1901). Voucher specimen: PEM R5441 (02° 20' 27"S, 09° 35' 33"E), 5 Oct., a recent hatchling crawling in the morning in bunchgrass prairie.

Psammophis cf. *phillipsii* (Hallowell, 1844). Voucher specimens: PEM R5451, (02° 20' 35"S, 09° 35' 46"E), 13 Oct.; USNM 561547, camp, 26 Oct.; GAM 071 (02° 20' 41"S, 09° 35' 34"E), 29 Oct.; GAM 072, camp, 2 Nov.; USNM 561548, 300 m S of camp, 2 Nov.; PEM R5857, (02° 20' 10"S, 09° 35' 27"E), 4 Nov. The taxonomy of the *Psammophis sibilans-phillipsii* complex in West and Central Africa remains confused. The lateral head coloration of LNP specimens (see Figure 2 and Ward et al., 2003: 15, 138) is similar to that of the specimen illustrated by Chippaux (1999, 2001: pl. 36) for *P. phillipsii*; although Hughes (2000: 31) stressed that that picture rather illustrated a *P. sibilans*. However, the specimen illustrated by Chippaux was caught near Cotonou airport, Benin (Chippaux, pers. comm., Nov. 2002). The meristic characters of the LNP specimens correspond to those given by Chippaux (*loc. cit.*) for *P. phillipsii*, except that the anal scale is divided in all. All specimens were collected in bunchgrass prairie. An adult (PEM R5451; Fig. 2) was excavated by day from the ending part of the nest burrow of a black-headed bee-eater (Meropidae: *Merops breweri*) in bunchgrass prairie. The burrow was 320cm long and reached a depth of 60cm. The

FIGURE 1: *Natriciteres fuliginoides* eating a small ranid *Phrynobatrachus auritus* in Loango National Park (W. R. Branch).

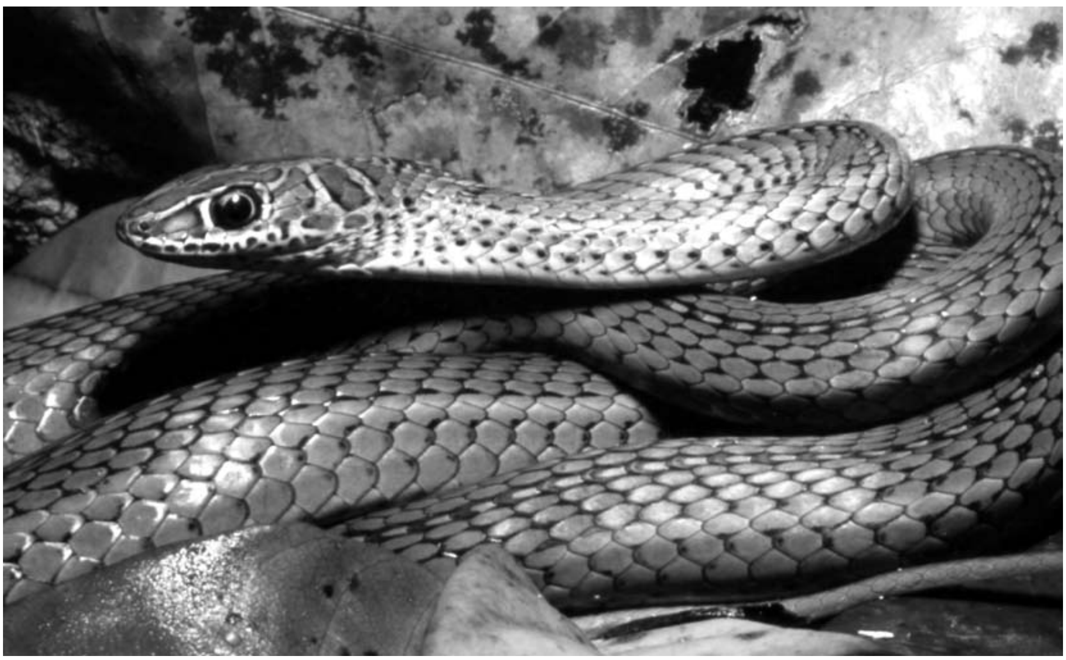

FIGURE 2: *Psammophis* cf. *phillipsii* from Loango National Park (W. R. Branch).

snake's stomach contained a chick of *M. breweri*. A juvenile (GAM 071) was found at night (23h00) sheltering in an isolated grass clump in flooded bunchgrass prairie. Another specimen (PEM R5857) was active in late afternoon (1640 h) by a temporary pond in bunchgrass prairie and tried to escape by diving underwater. Its stomach contained five adult *Hyperolius phantasticus,* two being ingested vent first.

Rhamnophis aethiopissa Günther, 1862. Voucher specimen: USNM 561538 (02° 19' 17''S, 09°36' 21''E), 26 Oct., found by day on a branch 1.6 m above the ground in open forest.

Thrasops flavigularis (Hallowell, 1852). Voucher specimen: PEM R5856 (02° 20' 42"S, 09° 35' 53"E), 5 Nov., was active at 16h20 in bunchgrass prairie, and tried to climb into a tree to escape.

Pythonidae:

Python sebae (Gmelin, 1789). No voucher specimen. The shed skin of a small juvenile was found on the beach about 5 km S of the camp on 24 Sept.

Typhlopidae:

Typhlops angolensis (Barboza du Bocage, 1866). No voucher specimen. An adult specimen (total L ca. 30 cm) was found in PT2 on 12 Oct., but subsequently escaped.

Viperidae:

Bitis gabonica (Duméril & Bibron, 1845). No voucher specimen. We examined the picture of an adult specimen taken by Nick Nichols in the park in January 2004. The specimen had been found on a lagoon island. Three specimens were observed by Nick Nichols and Mike Fay in the park during the megatransect in December 2001.

DISCUSSIONS

For a while the Loango area formed part of the French Congo, and data on "Loango" have been presented in old French papers dealing with the Congo Français. Boulenger (1900: 433) defined the "Gaboon district" as "the part of West Africa situated between Camaroons and Loango, in the French Congo". Although in old literature references to "Loango" are numerous, it is quite problematic to decide whether or not these are situated within the borders of LNP or even if they are situated in Gabon. For instance, Boulenger (1893: 47) cited "*Typhlops anomalus* (Bocage, 1873)" (in fact a *Rhinotyphlops*) from "South-west Africa (Mossamedes; Loango?)". Boulenger (1894: 287, 288, 358; 1896: 186, 263, 436, 509, 603, 616, 617, respectively) recorded from the "Mouth of the Loango": *Grayia caesar* (OSGP examined the specimen BMNH 94.8.4.13 from that locality), *G. smithii* (re-quoted by Boulenger, 1909), *Philothamnus heterodermus*, *Thelothornis kirtlandii* (Broadley, 2001: 66, mentioned a *T. kirtlandii* [BMNH 94.8.4.20] from the "mouth of the Loango", "Congo-Brazzaville"), "*Elapops modestus*", "*Dendraspis jamesonii*", "*Atheris squamiger*", "*Tropidonotus fuliginoides*", "*Boodon olivaceus*", *Hormonotus modestus* and "*Simocephalus guirali*". Boulenger (1900) listed *Lacerta echinata*, *Grayia smithii*, *Hormonotus modestus* and "*Simocephalus guirali*" from Loango. Boulenger long confused *Grayia ornata* and *G. smithii*; a specimen from "Sette Cama, Gaboon" was identified by him as *smithii* in 1894 and as *ornata* in 1909 (it is most probably BMNH 89.7.6.4 that OSGP examined and which is indeed *ornata*). Mocquard (1902: 410) mentioned *Leptodira Duchesnii* (sic) from "Loango" and "Setté Cama"; Rasmussen (1989: 256) listed the specimen MNHN 1900.2 from "Loango" in "Congo", and the specimen MNHN 1894.268 from "Setta Cama" (sic) in Gabon. Gans (1959: 154, 156) listed *Dasypeltis palmarum* from "Loango", Angola (!), based on Boettger (1888). Chippaux (2001: 109-10) indicated two dots situated in southwestern Gabon on the distribution map for *D. palmarum*, but in fact these dots were erroneously placed in Gabon (Chippaux, pers. comm., Jan. 2003). Boettger (1888) listed numerous species from "Loango" and various localities on "Loangoküste". For example, Boettger listed *Mabuia* (sic) *maculilabris* from "Tschintschoscho in Loango" (*loc. cit.*: 27), *Feylinia macrolepis* from "Massabe in Loango" (*loc. cit.*: 35), or *Philothamnus dorsalis* from "Molembo in Loango" (*loc. cit.*: 59). De Witte (1965: 51) mentioned *Chamaeleo d. dilepis*

(MNHN 1897.241) from "Loango", "République du Congo". De Massary (1993: Annex 3: vii) mentioned two specimens of *Causus maculatus* (MNHN 1973.1259-60) from "Loango, Congo". Trape & Roux-Estève (1995) listed 13 snake species (*Atractaspis congica*, *A. irregularis parkeri*, *Chamaelycus fasciatus*, *Dasypeltis palmarum*, *Dipsadoboa duchesnii*, *Hapsidophrys smaragdina*, *Lamprophis f. fuliginosus*, *Mehelya capensis savorgnani*, *Natriciteres o. olivacea*, *Dendroaspis j. jamesoni*, *Elapsoidea guentheri*, *Typhlops l. lineolatus*, *Causus maculatus* – the same as those mentioned by de Massary) from "Loango" and gave for that locality the geographic coordinates of a point (4°39'S, 11°48'E) situated in Congo Brazzaville. The Loango indicated on the map provided by du Chaillu (1863) seems to be situated more inland than the limits of LNP. Such a great confusion leads us to take into account only recent, unambiguous records, which seems also pertinent at a conservation point of view.

Although twelve snake species were recorded from LNP, only three were common: *Dipsadoboa duchesnii* in forest near ponds, *Natriciteres fuliginoides* in swamp forest, and *Psammophis* cf. *phillipsii* in bunchgrass prairie. Where it occurs, *Philothamnus carinatus* is often an abundant species (e.g. *Monts de Cristal* in northern Gabon, Pauwels et al. 2002b), and it is surprising that we found only a single recently-hatched specimen during the present survey. Despite its small size and abundance in the direct vicinity of our traps, *Natriciteres fuliginoides* was never captured in either funnel or pitfall traps. The largest reptile that we caught in a pitfall trap was an adult *Kinixys erosa* (on 17 Oct.) which had a curve carapace length of 294mm (total straight length of carapace and plastron until extremities of gulars 266mm). Pitfall (eight species) and funnel (six species) were not as effective as general searches in sampling reptiles, but did capture two species (*Lygosoma fernandi*, in both trap types; *Typhlops angolensis*, in pitfall trap only) that were not found by active searching. Only 12 snake species represents a low diversity compared to other reptile lists from Gabon (24 snake species were recorded at Lopé by Blanc and Frétey, 2000; 32 in the *Massif du Chaillu* and 32 in the *Monts de Cristal* by Pauwels et al., 2002a-b), and probably reflects under-collecting rather than a truly impoverished snake fauna.

The density of Red river hogs *Potamocherus porcus* was high in the park, as attested by their numerous tracks and our visual encounters in all sampled sites. Large land crabs were also common nearly everywhere, and dozens of specimens were found in the pitfall and funnel traps. The combined presence of these nocturnal animals could well be responsible for the low density or even the complete absence, of a number of expected terrestrial species (given their general geographic distribution) in the sampled sites. This could also explain the high proportion of (semi-) arboreal and/or diurnal squamates among the taxa recorded.

The lack of permanent water points in the area we surveyed could explain the apparent absence of aquatic species like *Grayia ornata* or *Hydraethiops melanogaster*, otherwise widely distributed and abundant in most parts of Gabon. Due to the overall similarity between the bunchgrass prairie at Loango and the savanna at Lopé, and the presence of several savanna dwelling taxa at Loango, we expect a number of additional savanna and ubiquitous species in Loango that were recorded at Lopé: for instance the occurrence of *Poromera fordii* (in grassy areas in forest near permanent streams) (Lacertidae), *Calabaria reinhardtii* (Boidae), *Aparallactus modestus*, *Dasypeltis scabra*, *Lamprophis olivaceus*, *Philothamnus heterodermus* (Colubridae), *Dendroaspis jamesoni*, *Naja melanoleuca* (Elapidae), *Typhlops congestus* (Typhlopidae), *Atheris squamigera*, *Bitis nasicornis* and *Causus maculatus* (Viperidae) seems very probable. Surveys of other parts of the park, like the Sounga area which offers permanent streams where the villagers told us that *Grayia ornata* was common, and cultivated lands, or the Iguéla zone, will undoubtedly bring a number of new records. All five sea turtle species known to occur in Gabon (Fretey, 2001) should be confirmed soon from LNP. Although no amphisbaenids were recorded during the Loango survey, both *Cynisca bifrontalis* and *Monopeltis galeata* were recently recorded from lowland

forest habitats in the Gamba Complex (Branch et al., 2003). These records were southern range extensions that straddle the LNP where both species may also occur.

CONCLUSIONS

Although Loango's herpetofauna did not prove to be extremely rich (comparable to Lopé with its 38 species but less than Monts de Cristal with 48 or Massif du Chaillu with 50), it offers a unique combination of West African grassland, forest and marine species. The presence of all three African crocodile species, as well as several other protected reptile species, among them three sea turtle species which nest on Loango's beaches, strongly justifies the pertinence of the protection of Loango's area. Nonetheless, a number of species will undoubtedly still be recorded from the park, especially among snakes. In total we believe that a list of about 50 reptile species can reasonably be expected for the park. Each new record will still increase the –already high- value of the park at a conservation and herpetological point of view.

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NOTES

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Recent records and comments on the distribution and conservation status of *Geochelone platynota* (Blyth, 1863) in the dry zone of central Myanmar

(with one text-figure)

The critically endangered Burmese star tortoise, *Geochelone platynota* (Blyth, 1863) is endemic to the dry zone of central Myanmar; however, its distribution within this region remains ill-defined and few locality records are available (Moll, 1989; van Dijk, 1997; Platt et al., 2000; IUCN, 2004). Early records from Moulmein (Mawlamyine), Rangoon (Yangon), and Pegu (Bago) (Blyth, 1863; Theobald, 1868; Smith, 1931; Iverson, 1992) are based on specimens obtained in markets and do not reflect the natural distribution of *G. platynota* (van Dijk, 1993). A reference by Abreu (1858) to Testudo radiata, a Madagascan species with a carapace pattern similar to *G. platynota*, encountered north of Toungoo (18° 53'N; 96° 23'E) is probably assignable to the latter. A *G. platynota* in the collection of the Zoological Society of India (ZSI 17049) was collected near Yenangyoung (20° 27'N; 94° 52'E) during the 1920's (Indraneil Das, pers. comm.), and Iverson (1992) reports another from Magwe (20° 08'N; 94° 57'E). More recently, *G. platynota* has been reported within the dry zone at Shwe Settaw (20° 11'N; 94° 28'E) and Minzontaung (21° 24'N; 95° 47'E) Wildlife Sanctuaries, and Myaleik Taung (21° 47'N; 96° 15'E) (van Dijk, 1993, 1994, 1997; Platt et al., 2001, 2003). Herein we provide additional recent records from hitherto unreported localities in the dry zone of central Myanmar.

The dry zone is a semi-arid region formed by the rain shadow of the Chin Hills and Arakan Yoma Mountains of western Myanmar (Fig. 1; Roberts et al., 1968). Annual precipitation ranges from 500 to 1000 mm, with most rainfall occurring during a brief period from late June to September. A prolonged dry season extends from October through early June (Terra, 1944; Scott, 1989). The vegetation of this region has been variously classified as thorn forest and thorn scrub (Stamp and Lord, 1923), dry forest (Hundley, 1961), and dry scrub and semi-desert scrub (Davis, 1964). Regardless of the classification system, the vegetation is characterized by xerophytic species such as *Acacia* spp., *Tectona hamiltoniana*, *Terminalia oliveri* and *Euphorbia* spp., with an understory of various grasses. Extensive bamboo (*Dendrocalamus strictus*) brakes are common in some areas.

We obtained the carapaces (without plastrons) of 10 *G. platynota* from seven localities (Fig. 1; Table 1) while conducting biodiversity surveys in central Myanmar during 2000 and 2001 (Platt, 2001a, 2001b). These specimens were salvaged after being harvested and consumed by villagers, and are currently housed in the natural history collection of the Wildlife Conservation Society Myanmar Program (Yan-

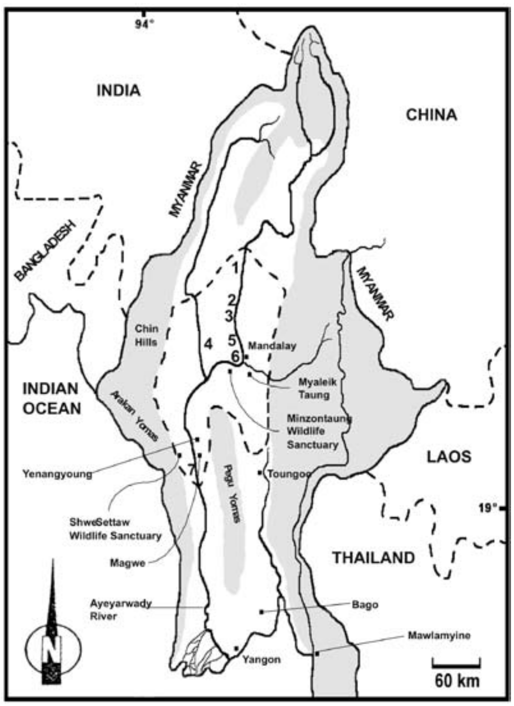

FIGURE 1: Map of Myanmar showing localities mentioned in text. Dashed line denotes approximate extent of dry zone. Hill ranges and mountains indicated by shading. Numbers correspond to collection localities in Table 1.

gon). The mean carapace length of the 10 shells is 185 ± 47 mm (range 100-249 mm). With a single exception, tortoises were harvested near the villages where we obtained them. Villagers in Sheinmaga obtained two shells through barter, but we were unable to determine their original collection locality. However, subsequent interviews in both Sheinmaga and Mau villages strongly suggest these tortoises were captured near the latter village. Hunters in Mau village reportedly collect tortoises in the wake of deliberately set dry season fires. This practice is widespread in the dry zone (Platt et al., 2001, 2003; S. Platt, unpubl. data) and has a long history; Theobald (1868) wrote that "vast numbers" perished when hunters ignited grass and brush to expose tortoises. The specimen from Padan Village was captured at the base of the Arakan Yomas. This area is adjacent to Shwe Settaw Wildlife Sanctuary, which formerly harboured a large population of *G. platynota* (Platt et al., 2001). Villagers provided little information for the Budalin specimen other than it was collected nearby. In addition to obtaining a carapace from Myinthar-Kyarnyut Village, we interviewed a wildlife trader who claimed to sell about 30 locally collected *G. platynota* each year. The specimen from Sing Khaing Village was collected in the nearby Sagaing Hills, located on the north-western periphery of the dry zone. Our interviews indicate that hunters routinely visit the Sagaing Hills to collect tortoises and the area warrants further investigation. Hti Chaing Town is located at the base of the Kachin Hills on the northern edge of the dry zone, and the two specimens we obtained there constitute the northernmost records of G. platynota in Myanmar.

The availability of shells in rural villages and towns underscores the continued vulnerability of *G. platynota* to harvesting throughout its limited distribution. The dry zone is a densely populated agricultural landscape (Roberts et al., 1968), and both commercial and subsistence harvesting of *G. platynota* appears ubiquitous throughout the region. Villagers we interviewed regarded *G. platynota* as uncommon or rare depending on the locale, and the only viable populations we have yet located occur at Minzontaung Wildlife Sanctuary and Myaleik Taung (Platt et al., 2003). Even within protected areas *G. platynota* remains vulnerable to poaching as the recent (post 1990) demise of populations at Shwe Settaw Wildlife Sanctuary attests (van Dijk; 1993; Platt et al., 2001). Finally, further surveys are warranted in the dry zone, as improved resolution of distributional data can affect conservation priorities (Stuart and Thorbjarnarson, 2003).

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TABLE 1: Burmese star tortoise (*Geochelone platynota*) specimens obtained in the dry zone of central Myanmar during 2000 and 2001. Numbered locations correspond to Figure 1. Carapace length (CL) presented as mid-line carapace length.

Location	Latitude (N)	Longitude (E)	CL (mm)	Comments
1. Hti Chaing Town	23° 44.8'	96° 08.9'	181, 249	Northernmost record in Myanmar
2. Myinthar-Kyarnyut Village	23° 14.5'	95° 59.4'	238	
3. Mau Village	22° 40.7'	95° 54.3'	100, 153	
4. Budalin Village	22° 25.1'	95° 10.0'	166	
5. Sheinmaga Village	22° 16.8'	95° 58.9'	164, 238	Provenance uncertain; probably captured near Mau Village.
6. Sing Khaing Village	22° 11.7'	95° 59.4'	215	Captured in Sagaing Hills.
7. Padan Village	20° 00.0'	94° 31.2'	153	Captured in foothills of Arakan Yoma Mountains near Shwe Settaw Wildlife Sanctuary.

specimen in the collection of the Zoological Society of India to our attention.

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Microhyla heymonsi Vogt, 1911 (Anura: Microhylidae) from mainland India, with bioacoustic analysis of its advertising call

(with two text-figures)

Microhyla heymonsi, a tiny narrow mouthed frog, has a wide geographical distribution and reported to occur in China, Vietnam, Cambodia, Laos, Thailand, Peninsular Malaysia, Singapore, Indonesia and Myanmar. In India, it is recorded only from Great Nicobar (Sarkar, 1990, Daniels, 2002). Both China and Myanmar have political boundaries with India and *M. heymonsi* is widely distributed in several localities of both these countries. Chanda (2002) have recorded three species of *Microhyla*, *M. berdmorei*, *M. ornata* and *Microhyla rubra* from the Indian mainland, but not *M. heymonsi*. The present communication reports the occurrence of the species in Silchar, Assam, and providesa description of a male and analysis of the advertising call.

The Assam University, Silchar (Assam, India) campus has a ca. 100 ha. patch of degraded open forest (24o 41’ 36.5”N; 92o 45’ 02.3”E + 0.4” Geodesic system WGS 84; alt. 59 + 10 m) dominated by tree species such as *Artocarpus chaplasha*, *Bombax ceiba*, *Ficus bengalensis* and a fairly dense secondary growth of *Melocanna baccifera*, *Dillenia pentagyna* and others. The area is traversed by several small water channels, and has several ephemeral water bodies. Amphibians recorded include *Hoplobatrachus tigerinus*, *Fejervarya* aff. *limnocharis*, *Euphlyctis cyanophlyctis*, *Microhyla ornata* and *Polypedates leucomystax*.

The study area was surveyed by active searching to document amphibians. We came across a calling male *Microhyla* hidden under leaf litter at 0030 h on 3 September 2002. The call was a repeated clicking sound, recorded with a portable minidisk recorder Sony MZ-N707 (sampling frequency 44,1 kHz, bandpass 20-20.000 Hz) and a Sennheiser K6-CL microphone with Sennheiser ME 67 head. The distance between the calling male and the tip of the microphone was ca. 20 cm. Oscillograms and spectrograms were obtained using Avisoft SASLab Pro Ver. 3,5b R. Specht 1998 through the Fourier Transformation (frequency resolution 55 Hz, 1024 points, time resolution 0,73 ms and the Hamming-window). Terminology used is after Roy and Elepfandt (1993) and Roy et al. (1998). Natural history notes were taken, the specimen was photographed before fixation, preserved in 10% formalin for morphometric measurements and deposited in the Museum of Department of Ecology and Environmental Science, Assam University, Silchar (Reg. No. SIL 030902/16). All measurements were taken with a Mitutoyo dial vernier caliper (505-633-50, Japan) (Table 1).

The mature male collected is small and stout (SVL 24.40 mm). Hind limbs moderately long (35.65 mm). Tibia long (TBL:SVL = 0.47), ca. x 3 longer than wide (TBL:TBW = 2.90), and ca. x 1.5 longer than thigh (TBL:TH = 1.52). Tibio-tarsal articulation reaching anterior corner of eye. Toe tips dilated into small discs, which are without circummarginal grooves. Toes 1/4 webbed, webbing formula I 1-2 II 2-2½ III 2-3 IV 3-2½ V. A small-elongated inner metatarsal tubercle and a strong pointed outer metatarsal tubercle present. Relative lengths of toes T4 > T5 > T3 > T2 > T1.

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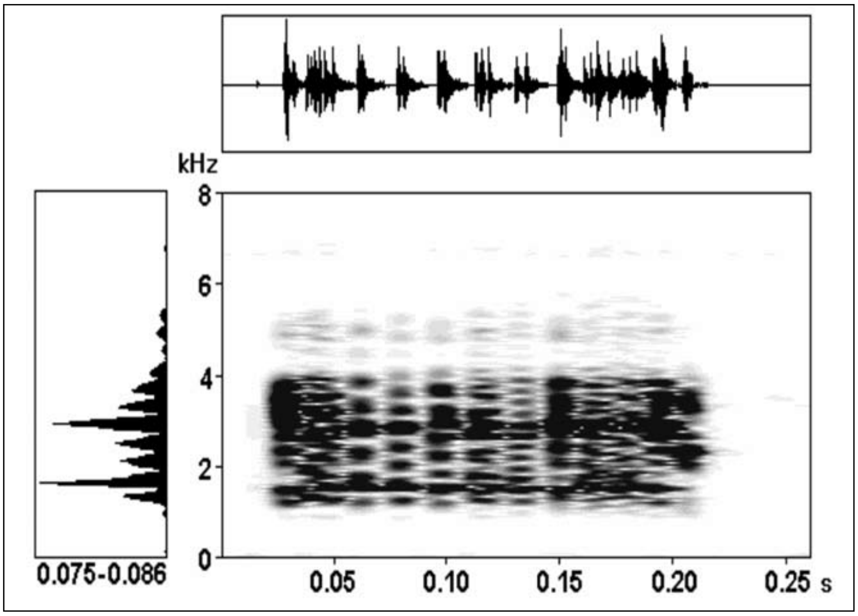

FIGURE 1: Call of *Microhyla heymonsi*. Oscillogram and spectrogram of a continuous series. On left, frequency spectrum of a pulse group.

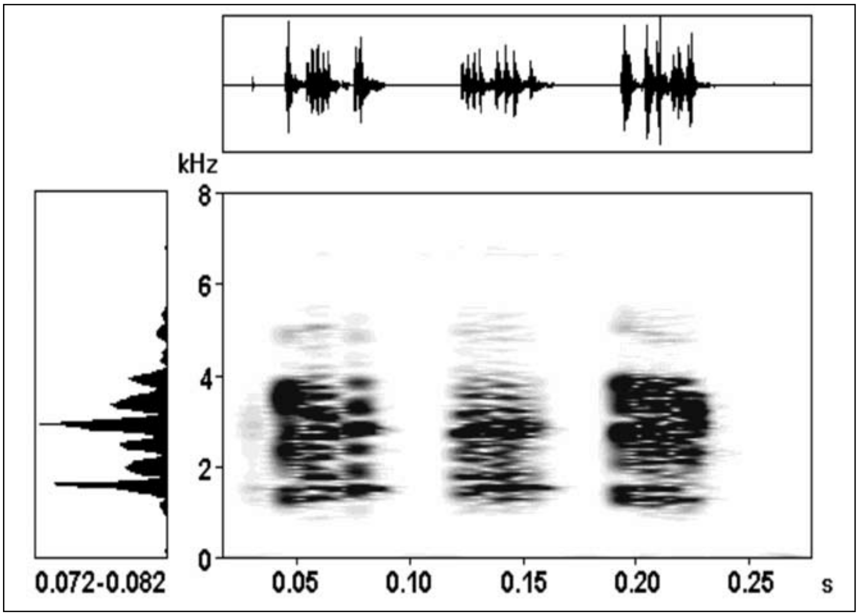

FIGURE 2: Call of *Microhyla heymonsi*. Oscillogram and spectrogram of a discontinuous series. On left, frequency spectrum of a pulse group.

Dorsum light grey with a distinct median line. A black triangular anal spot; side of head and body with dark black band extending to near groin; venter cream; chin and throat sprinkled with dark pigmentation

Calls of this specimen were produced in four series of 20, 6, 17 and 16 calls separated from each other at 8821, 8362 and 1222 ms, respectively. Call duration was of 171 ± 33 ms (n = 59), with inter-call intervals of 378 ± 174 ms (n = 55). Calls consisted of 17 ± 5 (n = 59) pulse groups with duration of 11 ± 2 ms (n = 981). They were introduced by a weak and distinct pulse, and were composed either of a continuous series of pulse groups (Fig. 1), or of series separated by one or two silent intervals (Fig. 2). Consequently, the envelope curve is inflicted by this property and its appearance is irregular. However, we distinguish few constant features in its structure: it starts and ends with strong (large amplitude) and interspersed pulse groups. Between these limits, we observed more distinct pulse groups, with 7 to 13 spectral harmonics. Sidebands reflect the pulsatile nature of each pulse (Heyer, 2003, pers. comm.). Inside calls, dominant frequencies change according to time. Of the 59 analysed calls, we found two dominant frequencies: a lower one at 1510 Hz and an upper one at 2840 Hz. From -40 to -20 dB, the minimal frequency is 1378 Hz and the maximal one is 3747 Hz. Sometimes, calls end by a medium frequency of 2090 Hz. Pulse rate varies from 26 to 39 pulses/sec.

From the morphological description and comparisons with voucher specimens at the Zoological Survey of India, Kolkata, India, the specimen was identified as *Microhyla heymonsi*. Furthermore, the bioacoustic analysis agrees with earlier studies by Heyer (1971) and Kuramoto (1987).

Thanks are due to S. K. Chanda, Zoological Survey of India, for confirming the identification of the species.

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On neotype designations for *Coronella cyclura* Cantor, 1839 (Serpentes: Colubridae)

Oligodon cyclurus (Cantor, 1839) is a relatively widespread species (distribution: Assam in north-eastern India, east through southern Chi-

Dorsum light grey with a distinct median line. A black triangular anal spot; side of head and body with dark black band extending to near groin; venter cream; chin and throat sprinkled with dark pigmentation

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The species was originally described as *Coronella cyclura* Cantor, 1839 on the basis of a coloured sketch at the Bodleian Library, Oxford University, and no type locality was designated (Smith, 1943: 202). Taylor (1965) stated that the type(s) are lost. Two authors have independently designated neotypes for the species. Campden-Main (1970) designated USNM 72067 from "Bangkok, Thailand" (13º 45'N; 100º 31'E, Phra Nakhon Province, Thailand; see also Saint Girons, 1972), while Wagner (1975) apparently unaware of Campden-Main's (1970) action, designated BMNH 1940.3.4.41 from "Kalinganz, Rangpur, Bangladesh" (Rangpur at 25º 44'N; 89º 16'E, in northern Bangladesh), as the neotype of Cantor's (1839) species.

Wagler's (1975) thesis is nomenclaturally unavailable, being an unpublished thesis (Article 8.1.3 of the International Code of Zoological Nomenclature, Fourth Edition; International Commission of Zoological Nomenclature, 1999). Campden-Main's (1970) work being the older of the two in any event (Article 75.4 of the Code), USNM 72067 from "Bangkok, Thailand" is confirmed as being the neotype of Oligodon cyclurus (Cantor, 1839).

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On the identity of *Amphiesma venningi* (Wall 1910) reported from Meghalaya, India

Gayen (2001) reported *Amphiesma venningi* (Wall, 1910) from Meghalaya, based on a specimen collected from Narpuh Reserve Forest, Jaintia Hills district in September 1998 by N. Sen. An examination of the said specimen by us reveal certain inaccuracies in the determination of its identity. We record here the various morphological characters of the specimen observed by us. The scale counts are after Smith (1943). Dorsal scales in 19: 19: 17 rows, keeled; ventrals 157; subcaudals (excluding the terminal scale) 82, all single; anal 2; supralabials 9, 4th, 5th and

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On the identity of *Amphiesma venningi* (Wall 1910) reported from Meghalaya, India

Gayen (2001) reported *Amphiesma venningi* (Wall, 1910) from Meghalaya, based on a specimen collected from Narpuh Reserve Forest, Jaintia Hills district in September 1998 by N. Sen. An examination of the said specimen by us reveal certain inaccuracies in the determination of its identity. We record here the various morphological characters of the specimen observed by us. The scale counts are after Smith (1943). Dorsal scales in 19: 19: 17 rows, keeled; ventrals 157; subcaudals (excluding the terminal scale) 82, all single; anal 2; supralabials 9, 4th, 5th and

6th touching the eye; preocular 1; postoculars 3; loreal 1; nasal 2; temporals 1+1; internasals shorter than prefrontals, truncate; nostril lateral; maxillary teeth 22, gradually increasing in size posteriorly. Dorsum greyish with indistinct black spots; a dorsolateral series of pale spots numbering 55 and 64 on either side in an interval of 2-4 scales; labials pale with black vertical bars; a pale line from the posterior part of the 9th supralabial to the nape; ventrally creamish with dark brown squarish spots on either side of the outer margins of the ventrals. Total length 760 mm, tail 180 mm. These characters establish the identity of the specimen as *Amphiesma xenura* (Wall, 1907). The only discrepancy is in the number of the temporal scales. *Amphiesma xenura* is known to possess two anterior and posterior temporals each. However such discrepancies are not uncommon among natricine snakes. The specimen is registered as ZSI VR/ERS 107.

Smith (1943) gave the distribution of *Amphiesma xenura* as Cherrapunjee in Khasi Hills. Mathew (1995) reported two juvenile specimens from Tura in West Garo Hills district of Meghalaya. As for the occurrence of *Amphiesma venningi* (Wall, 1910) in India, the sole authenticated record is that of Captain and Bhatt (2001) from Arunachal Pradesh.

The authors are grateful to J. R. B. Alfred, Director, Zoological Survey of India, Kolkata and to S. J. S. Hatter, Officer-in-Charge, Eastern Regional Station, Zoological Survey of India, Shillong, for permission to study the material and for laboratory facilities.

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A first record of *Pareas carinatus* Wagler, 1830 (Serpentes: Colubridae: Pareatinae) on Bali, with notes on a tropical snake community

(with one text-figures)

On 20 July 2000, the staff of the Bali Reptile Park and myself surveyed the ophidian community at the Celuk River, Kabupaten Gianyar, Bali. From 2000 to 2300 h, the area was explored while slowly patrolling the approximately 60-120 cm deep and 4-5 m wide river. The river was densely vegetated on ca. 3-5 m of both sides, representing a retreat for the local snake fauna amidst a completely anthropogenically altered landscape intermingled with rice fields and human settlements.

During the survey period, 18 snakes belonging to six species were recorded. Of the diurnal species, seven varying size classes of *Ahaetulla p. prasina* were discovered at 1-5 m height (above the water surface) resting in long coils on the tips of branches and leaves. Three individuals of *Dendrelaphis p. pictus* were observed at heights of 1.5-5 m, but in contrast to *Ahaetulla p. prasina*, they were coiled closer to the tree stems. Two approximately 150 cm long *Ptyas korros* were sighted at about 2.5-3.5 m height above the water surface, perched in long coils in a dense riparian shrub (cf. Auliya, 2002).Three nocturnal species, one ca. 200 cm long *Python r.*

6th touching the eye; preocular 1; postoculars 3; loreal 1; nasal 2; temporals 1+1; internasals shorter than prefrontals, truncate; nostril lateral; maxillary teeth 22, gradually increasing in size posteriorly. Dorsum greyish with indistinct black spots; a dorsolateral series of pale spots numbering 55 and 64 on either side in an interval of 2-4 scales; labials pale with black vertical bars; a pale line from the posterior part of the 9th supralabial to the nape; ventrally creamish with dark brown squarish spots on either side of the outer margins of the ventrals. Total length 760 mm, tail 180 mm. These characters establish the identity of the specimen as *Amphiesma xenura* (Wall, 1907). The only discrepancy is in the number of the temporal scales. *Amphiesma xenura* is known to possess two anterior and posterior temporals each. However such discrepancies are not uncommon among natricine snakes. The specimen is registered as ZSI VR/ ERS 107.

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FIGURE 1: *Pareas carinatus*, showing the characteristic posterior head and nape colour pattern. Locality: Celuk River, Gianyar, Bali, 20.VII.2000.

reticulatus was discovered in a bamboo thicket at about 2-3 m height above the rivulet (cf. Auliya et al., 2002). Four specimens of *Trimeresurus insularis* (cf. Giannasi et al., 2001; Kuch, 2002) all active at body height were found amid riverine herb vegetation or tree branches overhanging the river (Fig. 1). Most surprising was the discovery of an individual *Pareas carinatus*, active on an herb about 30 cm above the water surface (Fig. 1), representing the first locality record for Bali. Mertens (1930) did not find this species on Bali but on Lombok, and interestingly, after more than 70 years, *Pareas carinatus* remained unconfirmed for Bali (Iskandar and Colijn, 2001). Of the 15 species of *Pareas* that are currently recognised, *P. carinatus* is geographically the most wide-ranging, occurring in China, Myanmar, Cambodia, Lao PDR, Viet Nam, Thailand, Malaysia and Indonesia (Iskandar and Colijn, 2001). Within the entire Indonesian archipelago, the species has been recorded from the Greater Sundas (van Hoesel, 1959; Hodges, 1993; David and Vogel, 1996; Stuebing, 1991) and Lombok, east of the Wallace line, representing the species' eastern-most limit of distribution (How and Kitchener, 1997). The small body size, slow locomotion and secretive nature of this nocturnal species may be the cause of this rather recent discovery. At present, Bali harbours a minimum of 24 terrestrial snake species (Mertens, 1930; Iskandar and Colijn, 2001) (including *Python molurus*, MacRae, pers. comm.). Other species, also occurring east of Bali and on Java, but not yet recorded from Bali (such as *Oligodon bitorquatus*) may await discovery in the near future.

Surrounded by a greatly modified habitat, the ecological importance of these non-cleared gallery forest like stretches is obvious as they reveal assemblages of terrestrial and arboreal snake species. While terrestrial snakes retreat into their resting places i.e., *Ptyas korros*, arboreal species find refuge here (i.e., *Ahaetulla p. prasina*, *Trimeresurus insularis*). The arboreal *Dendrelaphis p. pictus* also displays terrestrial life habits hunting frogs amid riparian grass mats in Borneo (cf. Auliya, 2003).

The tropical snake community described here may trigger field studies investigating niche partitioning of diurnal and nocturnal snakes, all displaying arboreal habits for different purposes.

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Observation on the breeding of *Mabuya macularia*

On 1 September 2003, I found two small white reptile eggs at the gardens of the Sayaji Baug Zoo, Vadodara, Gujarat State, India. Both eggs were found uncovered near a thick pile of decaying grass, on the earth. The size, oval shape and luster of the eggs and their situation in the environments indicate that they are might have

TABLE 1: Breeding data on *Mabuya macularia*. Abbreviations: TBL = total body length; SVL = snout-vent length; TL = tail length.

No.	Date eggs found	Clutch size	Egg size	Date of hatching	Incubation period (days)	Mean size of hatchling TBL = SVL + TL
1.	1 Sep.2003	2	10.24 x 7.52	28 Sep.2003	28	42.25 = 18.75 + 23.50
2.	10 Sep.2003	2	10.44 x 7.88	25 Sep.2003	15	46.00 = 19.50 + 26.50
3.	10 Sep.2003	2	10.31 x 7.33	25 Sep.2003	15	46.00 = 19.00 + 27.00
4.	10 Sep.2003	2	10.86 x 7.36	29 Sep.2003	19	50.00 = 22.00 + 28.00
5.	14 Sep.2003	3	10.64 x 7.80	3 Oct.2003	19	51.00 = 20.33 + 30.67
6.	14 Sep.2003	2	10.63 x 7.22	6 Oct.2003	22	45.00 = 19.50 + 25.50
7.	14 Sep.2003	2	9.64 x 6.90	-	-	Both eggs spoilt

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been freshly laid by a skink. Both eggs were transferred to the laboratory.

Eggs were measured with verniers calipers (Table 1) and kept for incubation in a plastic box, which contained wet soil, at room temperature. Subsequently, I found a total of 13 eggs from six different locations. In all, 15 eggs were collected within a 2 x 20 m garden plot near the tiger enclosures of the Sayaji Baug Zoo, which is situated on the banks of the Vishwamitri River, Vadodara. All eggs were taken to the laboratory for incubation under the conditions mentioned.

The area where the eggs were found is regularly visited predators such as the small Indian mongoose (*Herpestes auropunctatus*) and the Bengal monitor (*Varanus bengalensis*).

The average egg dimensions were 10.42 (9.64–10.86) x 7.43 (6.90–7.88) mm (n = 15). A total of 13 hatchlings emerged after an average incubation period of 20 (15-28 days: n = 6) days. Average hatchling length was 46.7 mm from snout to tip of the tail (snout to vent length 19.8 + tail length 26.9 mm). All hatchlings were dark brown. The scales of the upper lips were white with brown edges. There were white spots from temple region to the anterior edge of the fore limb. The belly was white. The hatchlings showed all characters of *M. macularia*.

Minton (1966) recorded gravid female of the species from July to September and young ones were observed in late July through early October. He also observed unattended clutches of eggs of the species under the piles of decaying grass at Pakistan. Inger et al. (1984) recorded eight clutches (each comprising two eggs) with eggs measuring 13-15 x 0.69-0.81 mm, all eggs found under dead leaves and rotting logs at Ponmudi, Kerala, southern India. Daniel (2002) collected females of the species, each containing three to four eggs, in the month of June. The egg size from this study is smaller than the earlier recorded egg size by Inger et al. (1984) in Kerala.

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First record of *Ramphotyphlops braminus* (Serpentes: Typhlopidae) from Gabon, western central Africa

An interview with the gardener working in the flower plantations in front of the WWF office in the Quartier Louis, Libreville, Estuaire Province, Gabon, revealed that he often encountered tiny black snakes while digging. The following day, on 23rd January 2004, he brought us a live adult *Ramphotyphlops braminus* (Daudin, 1803). Our survey (CC, BCO, OSGP) at the same locality (0°24'27"N, 9°25'52"E) on the afternoon of 26th January revealed three more specimens (two adults and a juvenile) in less than five minutes, indicating that the species is indeed locally very abundant. Two of the adults made use of their caudal spine to defend themselves when caught by hand. The four specimens were found in soft soil, less than ten centimeters under the surface. They were preserved and deposited at the Direction de la Faune et de la Chasse, DFC, in Libreville (2 unnumbered specimens, but accompanied with a label with locality data) and at the Institut Royal des Sciences Naturelles de Belgique (2 specimens, IRSNB 16780 and IRSNB 16784). The gardener himself suggested that the species might have been imported with the flower pots; this locality is also situated just a few hundred meters from Libreville's harbour

been freshly laid by a skink. Both eggs were transferred to the laboratory.

Eggs were measured with verniers calipers (Table 1) and kept for incubation in a plastic box, which contained wet soil, at room temperature. Subsequently, I found a total of 13 eggs from six different locations. In all, 15 eggs were collected within a 2 x 20 m garden plot near the tiger enclosures of the Sayaji Baug Zoo, which is situated on the banks of the Vishwamitri River, Vadodara. All eggs were taken to the laboratory for incubation under the conditions mentioned.

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(Port-Môle). Another specimen was found by one of us (JPB) on the morning of 11 February 2004 in the leaf litter of a garden in the residential Quartier La Sablière, in the northwestern part of Libreville. The natural soil of this garden (0°28'29"N, 9°23'46"E) situated less than 40 meters from the sea is sand, but it had been covered several years ago by imported earth for gardening purposes. This latter specimen was also deposited at the DFC. JPB had already caught an adult specimen (not preserved) in 1987 in the Quartier Quaben, in the center of Libreville. It was found among rotten paper on the ground inside a delapidated house (0°24'38"N, 9°25'54"E). All five examined specimens have 20 scale rows around midbody. Although it is clear that this species is already long established and widespread in the capital city Libreville, these specimens represent a new genus and species record for Gabon (Frétey and Blanc, 2004). On the Atlantic coast of Africa, the species was formerly known only from Dakar, Abidjan, Annobon Island and Douala (Jesus et al., 2003; LeBreton, 1999; Roux-Estève, 1974; Trape, 1990; Trape and Mané, 2002). *Ramphotyphlops braminus* is the fifth typhlopid species so far recorded from Gabon, after *Rhinotyphlops caecus*, *Rhinotyphlops* sp., *Typhlops angolensis* and *T. congestus* (Frétey and Blanc, 2004; Pauwels et al., 2002a&b; Roux-Estève, 1974). The present new records are part of the results of surveys sponsored by WWF Ecoregion Program. We thank Els Cornelissen (MRAC, Tervuren), André Kamdem Toham and Prosper Obame Ondo (WWF-CARPO, Libreville), Jean-Pierre Vande weghe (ADIE, Libreville), Lucien Obame (IRAF, Libreville), Georges Coulon and Georges Lenglet (IRSNB, Brussels), Richard Oslisly (WCS Gabon) and Amadou Konare (Libreville) for their kind help.

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Ophiophagus behavior in *Psammodynastes pulverulentus* in the Philippines

Psammodynastes pulverulentus (Boie) is a mildly venomous colubrid snake, common in the Philippines. Throughout its range it occupies rain forest habitats from sea level to ca. 2,000 m a.s.l. (Hoesel, 1959; Malkmus et al., 2002), although it prefers hilly or mountainous regions (Alcala, 1986). During forest vegetation studies in the western foothills of the Leyte Cordillera on the island of Leyte, Philippines, I encountered this snake on a fern leaf frond, ca. 50 cm above ground beside a trail. The locality was only a few meters away from a small creek, which is a tributary of the Pangasugan River that flows into the Camotes Sea north of the Leyte State University. The place is locally known as Bato and used by hunters as a camp site, and its elevation is ca. 400 m a.s.l.

The observed *Psammodynastes pulverulentus*, which was about 30 cm long, was lying on the fern leaf and feeding upon a *Rhabdophis* sp. (a water snake) of approximately the same size. This is the first record of ophiophagy in P. *pulverulentus* (Arvin Diesmos, pers. comm., April 2004). Published reports on the diet of *P. pulverulentus* only mention lizards and frogs (Hoesel, 1959; Lim and Lee, 1989; Malkmus et al., 2002).

I would like to thank Arvin Diesmos of the Wildlife Conservation Society of the Philippines for the information and the identification of the snakes, and Van Wallach for comments on a draft.

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LISTE DES REPTILES D'AFRIQUE CENTRALE

by Thierry Frétey and Charles P. Blanc. No date.
Les dossiers de l'ADIE. Série Biodiversité N° 2. Agence Internationale pour le Développement de l'Information Environnementale, Libreville. 73 pp. In French. Softcover.
Available from: ADIE, B.P. 4080, Libreville, Gabon.
Tel. (241) 444932/444926; Fax: (241) 444945;
E-mail: urgc@adie-prgie.org. Price: US $ 12.

Synthetic works on the rich tropical African herpetofauna are missing, and in this respect the recent work of Frétey and Blanc, intended to list all reptile species of seven central African countries, is a very welcome addition. Although no date appears in the publication, it was submitted to ADIE in late 2001 and effectively out-dated when distributed in late March 2004 (Thierry Frétey, pers. comm.; Jean-Marie Ndong Nzue, PSP Libreville, pers. comm.; Jean-Pierre Vande weghe, ADIE, pers. comm.). We got our copy in Libreville in early April 2004. The volume is numbered "2" in the ADIE Biodiversity Series, but is in fact number 3, after two volumes dedicated respectively to the birds and amphibians of the same countries. The foreword states that the aims of the present work are: (1) to make available an update of all knowledge gathered to date on the reptiles of the area; (2) to contribute to the establishment of a database on the Central African vertebrate fauna; and (3) to contribute to the formation of a "tableau de bord de l'environnement" (monitoring chart of the environment).

The area covered by the work includes Cameroon, the Central African Republic, Congo, the Democratic Republic of Congo, Equatorial Guinea, Gabon, and the islands of São Tomé and Príncipe. After a brief introduction, the larger part of the work (pages 13 to 52) is a table of taxa with the presence of a species in each country indicated by a dot. The list is followed by an impressive literature section of 20 pages. The authors did not indicate a cut-off date for literature, but an examination of the references shows the latest is from 2001. However, even for 2001 some essential publications, such as the major work of Chippaux (2001) on West and Central African snakes, are missing. A number of local inventories have also been published subsequently, implying additions to the herpetofaunas of several countries, notably the Congo (Maran, 2002: addition of the formerly Gabonese endemic terrapin Pelusios marani), Equatorial Guinea (De la Riva, 2004; Lasso et al., 2002; Watkins-Colwell and De León, 2003) and for Gabon (Bauer and Pauwels, 2002; Pauwels, 2004; Pauwels et al., 2002; the latter notably adding the formerly Cameroonese endemic aquatic snake Hydraethiops laevis). Since 2001 some species were also withdrawn from national lists (Pauwels and Branch, 2003). The references section is somewhat problematic. On page 5, we read that the literature was arranged country by country, which is actually not the case. A long list of 662 references was compiled, but 11 are listed twice. Among the 651 remaining, 79 (12 %) are not correctly arranged by alphabetical order. There are no bibliographical references in the species list, hence no link between the quoted taxa and the literature cited, making the latter mostly unusable.

Species numbers for some countries are in contradiction with those found in other works. For example Frétey and Blanc listed 12 non-marine chelonians from Gabon, but Maran (2002) recognized the presence of only nine. They also listed 160 reptile species from Gabon, but Lötters et al. (2000) listed only 95 for that country. Unfortunately, with no references in the species list, there is thus no way to know on which references Frétey and Blanc based their assertions. There are a number of typos, and the use of italics for Latin names is irregular, but these are minor errors.

If the 2nd and 3rd objectives of the present work were partly fulfilled, it is certainly not the case for the first objective. A good deal of the knowledge on the listed species is not gathered nor referred to in the present work, and a very

long list of references on their ecology, care in captivity, ethnozoology, etc., etc., could have been added. Despite these shortcomings, mostly inherent to that kind of large-scale bibliographical work and also to the unfortunate publication delay, I regard this contribution as a useful landmark. It is an essential tool, being the only publication to date to give a synopsis – even if somewhat imperfect - of the herpetological riches of these seven, still poorly studied, Central African countries.

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SNAKES AND THEIR WAYS

By C.H. Curran and Carl Kauffeld Original Edition 1937, Reprinted by Krieger Publishing Company, Krieger Drive, Malabar, Florida, 2003. 285 pp.ISBN 1-57524-229-X
Price: unknown.

Whenever we get a book parcel from Krieger Publishing Co. it's a bit like Christmas and this time was no exception. Seeing the late great Carl Kauffeld's name on a new book was a bit of a shock but it was quickly obvious that here was a reprint of Curran and Kauffeld's excellent work. Out of print for forty years. "Snakes and Their Ways" is a general snake book, simply written, packed with facts, first hand experience and sparkling anecdotes.

Delving into it, "Snakes and Their Ways" is like a little (285 pages) encyclopedia. There are seventeen chapters running from Chapter I "General Considerations" which is your snake primer, through chapters on snakebite (a bit dated of course), rattlers, vipers, tree snakes, cobras and one on snakes in religion. The book ends with a list of American snakes but the rest of the book covers the world.

While the snakebite treatment bit is way out of date there is very little you can quibble with in the rest of the book. The anecdotes, both scientific and fanciful are what make this book agelessly entertaining. How about Dr. Eigenberger who is so interested in the effects of snake venom that he tries out little doses on himself. Having tried various rattlesnake venoms the good doctor gives himself a tenth of a

long list of references on their ecology, care in captivity, ethnozoology, etc., etc., could have been added. Despite these shortcomings, mostly inherent to that kind of large-scale bibliographical work and also to the unfortunate publication delay, I regard this contribution as a useful landmark. It is an essential tool, being the only publication to date to give a synopsis – even if somewhat imperfect - of the herpetological riches of these seven, still poorly studied, Central African countries.

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SNAKES AND THEIR WAYS

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Malabar, Florida, 2003. 285 pp.ISBN 1-57524-229-X
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Whenever we get a book parcel from Krieger Publishing Co. it's a bit like Christmas and this time was no exception. Seeing the late great Carl Kauffeld's name on a new book was a bit of a shock but it was quickly obvious that here was a reprint of Curran and Kauffeld's excellent work. Out of print for forty years. "Snakes and Their Ways" is a general snake book, simply written, packed with facts, first hand experience and sparkling anecdotes.

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drop of green mamba venom and starts developing very alarming symptoms. Doctor E. survived and wrote some fascinating notes on the effects but in those pre-antivenom serum days it was a pretty wild stunt. Interestingly, the authors state that in snakes used by Asiatic snake charmers “the fangs are seldom if ever removed from the performing snakes.” Does this mean that snake charmers had much more integrity in 1937 or that our authors were victims of some Indian mythology?

I just finished the last three chapters “Sea Snakes and “Sea Serpents”,” “Snake Stories,” and “Snakes in History and Religion” and the choice of material the authors so rigorously researched is excellent. All through the book are references to and by the snake men of that period: India’s own Frank Wall, Africa’s Vivian Fitzsimmons, America’s Raymond Ditmars and Clifford Pope. These gentlemen, especially Wall, are my gurus and I just wish there was more about the men themselves.

Back in the early ‘60s I read Karl Kauffeld’s “Snakes and Snake Hunting” and set about visiting his favourite spots. I found gila monsters along the Ajo Road in Arizona, Willard’s rattlers up in the Huachuca Mountains and those dark eastern diamondback rattlers at Oketee in South Carolina. I wrote to Mr. Kauffeld expressing my thanks for turning me on to these great places and he replied right away. He wrote that he now regretted describing the exact spots where he found so many wonderful snakes. He’d heard that indiscriminate, commercial snake hunters were hammering these habitats and cleaning them out. Kauffeld’s fears were well founded and these days it is deemed not advisable to give detailed locality data even in a scientific paper for fear of the commercial collectors.

“Snakes and Their Ways” is a real good first book on snakes to give to someone and has a lot to offer any curious naturalist. There are 32 pages of black and white photographs and a detailed Index. This is one of the classics.

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SECOND ANNOUNCEMENT
Fifth World Congress of Herpetology
19-24 June 2005, Stellenbosch, South Africa

The Local Organising Committee is pleased to announce the hosting of the 5th World Congress of Herpetology (5th WCH) on 19-24 June 2005 in Stellenbosch, South Africa. This Congress is designed to bring together herpetologists from all over the world to present, discuss and debate recent developments in herpetology and offers those in the herpetological field an excellent opportunity for oral and poster presentations, exhibitions and business meetings.

South Africa, regarded as the country with the highest reptile diversity on the African continent, is host to 5 species of sea turtle, 9 species of freshwater terrapin and 14 species of land tortoise. Further, 148 snake species and at least 281 lizard species are recognised. More than 83 new reptiles have been described since 1988, and research into the taxonomy and phylogenetic relationships of South African reptiles continue to unveil new taxa. At least 115 frogs are currently recognised and 34 new taxa have been added to the total since 1964.

The latest information on the Congress is available on the 5th WCH website: http://www.wits.ac.za/haa/5wch.htm

Call for Titles and Abstracts

This Announcement serves as an invitation to authors to submit a title and abstract for oral and/or poster presentations to be considered by the Scientific Committee for inclusion in the 5th WCH 2005 scientific programme. Similar to previous Congresses, authors are invited to submit titles and abstracts on herpetological methods and approaches, paleo-herpetology, evolution, taxonomy, systematics and phylogenetic relationships (including phylogeography) of amphibians and reptiles, as well as the morphology, growth and development, ecology, behaviour, reproduction, population biology, physiology, parasitology, breeding in captivity, zoogeography, impact of human activities on herpetofauna, and conservation strategies and action plans for selected species, populations and herpetological communities.

Authors wishing to submit abstracts must submit a title and a 250 - 300 word abstract along with the submission form by no later than 19 October 2004.

Please contact the Secretariat for a copy of the submission form or download it from the website: http://www.wits.ac.za/haa/5wch.htm

Please note that the Scientific Committee received a number of symposia topics for inclusion in the Congress. If you have been contacted by a symposium organiser to present a paper as part of a symposium, please indicate this on the submission form. If you need more information on the symposia topics, please contact the Scientific Committee chair, Aaron Bauer at: aaron.bauer@villanova.edu

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For information on the Fifth World Congress of Herpetology and the Baker Tilly World Conference 2005 please contact the Secretariat at: deidre@iafrica.com

ERRATUM

Kaestlea: a new genus of scincid lizards (Scincidae: Lygosominae) from the Western Ghats, south-western India. Hamadryad 28(1 & 2):43–50.

Lygosoma travancoricum var. *palnica* was described by Boettger (1892), rather than by Boulenger (1882) (p. 44 under referred specimens). The authority was cited correctly on p. 48.

The lectotype designation, for BMNH 1946.8.16.53, for *Lygosoma travancoricum* var. *palnica* is invalid, as Mertens (1967) designated one of the syntypes from Boettger's original syntype series from the Senckenberg Museum, Frankfurt (SMF 14657), from "Kodaikanal, Palni Hills, Süd-Indien"). This specimen was photographed by Jakob Hallermann during an inventory of the scincid types of SMF in March 2004, and was cited subsequent to the original description of Boettger (1892) by Mertens (1922; 1967). However, Ouboter (1986), in his revision of the genus *Scincella* sensu lato did not refer to or examine the specimen.

Mertens' (1967) work being the older of the two lectotype designations, according to Article 75.4 of the International Code of Zoological Nomenclature, Fourth Edition (International Commission of Zoological Nomenclature, 1999, subsequently, 'The Code'), SMF 14657 is confirmed as the lectotype of *Lygosoma* (*Leiolopisma*) *travancoricum* var. *palnica* Boettger, 1892. The rest of the syntypes from the original series (SMF 14658 and BMNH 1946.8.16.53) are relegated to the status of paralectotypes (Article 74.1.3 of 'The Code').

We thank Jakob Hallermann, Biozentrum Grindel und Zoologisches Museum, Hamburg, for bringing Mertens' lectotype designation to our notice, and Aaron M. Bauer for literature.

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4 November 2004.

Referees for *Hamadryad* Vol. 29(1)

A. M. Bauer, R. M. Brown, P. David, A. C. Diesmos, S. K. Dutta, P. P. van Dijk, A. E. Greer, J. B. Iverson, Tzi-Ming Leong, W. P. McCord, E. O. Moll, H. K. Voris, V. Wallach, R. G. Webb, T. Ziegler.

INSTRUCTIONS TO CONTRIBUTORS

Hamadryad publishes original papers dealing with, but not necessarily restricted to, the herpetology of Asia. Reviews of books and major papers are also published.

Manuscripts should be only in English and submitted in triplicate (one original and two copies, along with three copies of all tables and figures), printed or typewritten on one side of the paper. Manuscripts can also be submitted as email file attachments. Papers previously published or submitted for publication elsewhere should not be submitted. Final submissions of accepted papers on disks (IBM-compatible only) are desirable. For general style, contributors are requested to examine the current issue of *Hamadryad*. Authors with access to publication funds are requested to pay US$ 5 or equivalent per printed page of their papers to help defray production costs. Reprints cost Rs. 2.00 or 10 US cents per page inclusive of postage charges, and should be ordered at the time the paper is accepted.

Major papers exceeding four pages (double spaced typescript) should contain the following headings: Title, name and address of author (but not titles and affiliations), Abstract, Key Words (five to 10 words), Introduction, Material and Methods, Results, Discussion, Acknowledgements, Literature Cited (only the references cited in the paper). Appendices follow the main paper. Descriptions of new taxa will be considered as major papers regardless of size. Abstracts (up to 150 words) should summarize the important findings of the paper and should avoid references. In case of descriptions of new taxa, diagnoses should be provided in the abstract. Special attention should be paid to accents and diacritical marks: if fonts are not available in the software or typewriter, these may be put directly on the hard copy of the manuscript by hand.

References should be in the following format:

Papers:
Blyth, E. 1854. Notices and descriptions of various reptiles, new or little known. Journal of the Asiatic Society of Bengal 23(3): 287–302.

Books:
Boulenger, G. A. 1885. Catalogue of lizards in the British Museum (Natural History). Second edition. Vol. 1. Geckonidae, Eublepharidae, Uroplatidae, Pygopodidae, Agamidae. British Museum (Natural History), London. xii + 436 pp + Pl. I–XXXII.

Chapters in books:
Steindachner, F. 1867. Zoologisher Theil, Band 1. Reptilien. In: Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. von Wüllerstorf–Urbair. Kaiserlich–Königlischen Hof–und Staatsdruckerie, Wien. 98 pp + Pl. I–III.

Unpublished reports:
Moody, S. M. 1980. Phylogenetic and historical biogeographical relationships of the genera in the family Agamidae (Reptilia: Lacertilia). Unpublished Ph. D. Dissertation, University of Michigan, Ann Arbor. 373 pp.

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Szczerbak, N. N. & M. L. Golubev. 1986. [The gekko fauna of the USSR and contiguous regions.] Nauka Dumka, Kiev. 231 pp; 8 pl. [In Russian.] English edition 1997, Contributions to Herpetology, Vol. 13. SSAR, Oxford, Ohio.

Tables should be comprehensive without reference to the text. Tables should follow the main body of the paper, and their desired location within the text indicated on the manuscript. Footnotes are generally not allowed. Line art and half tones are preferred as electronic files saved on compact disks or attached to email files. Black and white photographic prints and slide transparencies are accepted if they are sharp and show good contrast. Black and white photos should be printed on glossy paper at least 152 x 204 mm after being trimmed at right angles and should carry the name of the author and of the manuscript at the back. Illustrations should be preferably done with Indian ink on good quality tracing paper. All lettering should be done using high quality computer printouts or transfers. Illustrations should be planned to fit either one column (6.5 mm) or one page (14 mm) width, after suitable reduction.

All manuscripts received for *Hamadryad* are sent to two or more referees. Authors of papers describing range extensions and descriptions of new taxa should deposit their material in established systematic institutions and cite museum registration numbers. Range extensions not based on specimens, such as endangered or other protected species, may be based on photographs that are deposited in a recognized systematic institution.

Manuscripts should be sent by registered post to: Indraneil Das, Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia. Email: hamadryad2004@hotmail.com